Volume 16, Number 6
November-December
1961

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Land Use:
Challenge of the Sixties

Effect of Cover
and Soils on Runoff

A Quarter Century
with Districts

Irrigation in Hawaii

Soil Conservation
in a Changing World

Drainage in the
Imperial Valley

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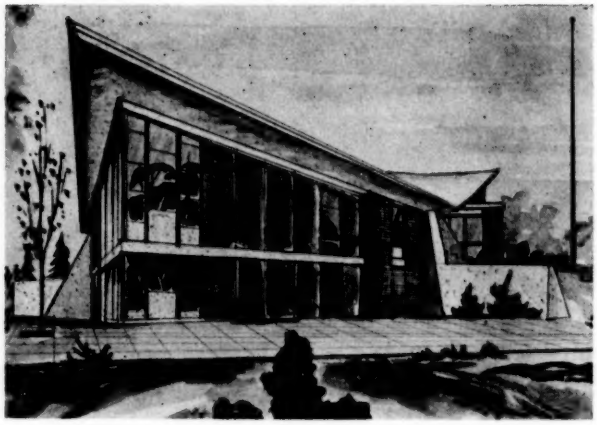
# THE SOCIETY IN ACTION!

*The remarkable growth of the building fund is shown by the report on page 252 of this Journal. Members and friends of the Society are wholeheartedly supporting the project through direct contributions, memorials established in the name of Hugh Hammond Bennett and other members, and by maintaining a sustaining membership in the Society.*

*Progress continues to be made toward the Society's goal of a new headquarters building. The drawing at the right was made from the final blueprints. It is planned that contracts for construction will be awarded during the last week in November.*

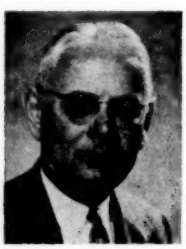


## NEW SOCIETY OFFICERS AND COUNCIL MEMBERS FOR 1962

**President: Roy D. Hockensmith,** Washington, D. C. A charter member of the *Society,* he was elected to the Degree of Fellow in 1957. In addition to serving on various *Society* committees, he is the author of several articles which have appeared in the JOURNAL OF SOIL AND WATER CONSERVATION. Since 1952 he has been director of soil survey operations for the Soil Conservation Service.

**First Vice President: George M. Browning,** Ames, Iowa. Since 1951 he has been associate director of the Iowa Agricultural Experiment Station. A charter member of the *Society,* he was elevated to the Degree of Fellow in 1958. He has served as chairman of the Iowa Chapter, contributed articles to the JOURNAL, and appeared on the *Society's* annual meeting program at Asheville, N. C.

**Second Vice President: Herbert A. Hopper,** Lafayette, California. For 6 years he has served as the Western Region Council Member and since 1954 has been chairman of the *Society's* Awards Committee. A charter member of the *Society,* he was accorded the Degree of Fellow in 1959. He has been field representative of the Soil Conservation Commission of the State of California since 1950.



**Treasurer: Howard F. Barrows,** St. Augustine, Florida. He helped organize and was first chairman of the award-winning Northern Illinois Chapter. In 1953, he was named an Honorary Member of the *Society* and has served as its Treasurer since 1956. Now retired, he was conservationist and advertising and sales promotion manager for the Austin-Western Company for more than 40 years.

**Council Member at Large: Cecil W. Chapman,** Athens, Georgia. Elected to the Degree of Fellow in 1960, he has been a member of the *Society* since 1946. He has served on various *Society* committees and has written several articles for the JOURNAL. Currently state conservationist for the Soil Conservation Service in Georgia, he has been with the Service continuously since 1934.

**Canadian Region Council Member: H. F. Crown,** Toronto, Ontario, Canada. He is a charter member of the Ontario Chapter of the *Society* and has served as chapter chairman. In 1960, he was in charge of publicity for the *Society's* annual meeting held at Guelph, Ontario. He is executive assistant to the Minister of Commerce and Development, Ontario Department of Planning and Development.

**Western Region Council Member: John R. J. Bradshaw,** Bountiful, Utah. A charter member of the *Society,* he has been president and vice president of the Utah Chapter and has served on the national Program and Chapter Activities Committees. A *Society* commendation award was presented to him in 1961. He is now the assistant state conservationist for the Soil Conservation Service in Utah.

Retiring Council members include **Elmer L. Sauer,** *Society* president during 1960; **Harold M. "Dutch" Rhodes,** who will continue his effective and diligent work as chairman of the Building Fund Committee; **N. R. Richards,** the first Canadian Region Council member.

**Walter C. Gumbel,** retiring president, will begin a 1-year term as ex officio member of the Council. Other individuals continuing to serve on the Council include **B. K. Geraghty, W. J. Huddleston, E. D. Bolton, Minott Silliman, Jr., D. J. Sacco,** and **Austin L. Patrick.**

TO ADVANCE THE SCIENCE AND ART OF GOOD LAND USE

# JOURNAL OF SOIL AND WATER CONSERVATION®

November-December

Volume 16
Number 6

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**COVER: A Tennessee farmer receives expert help from a forester in marking a mixed pine and hardwood stand for selective cutting.**

*SCS Photo by Harrison*

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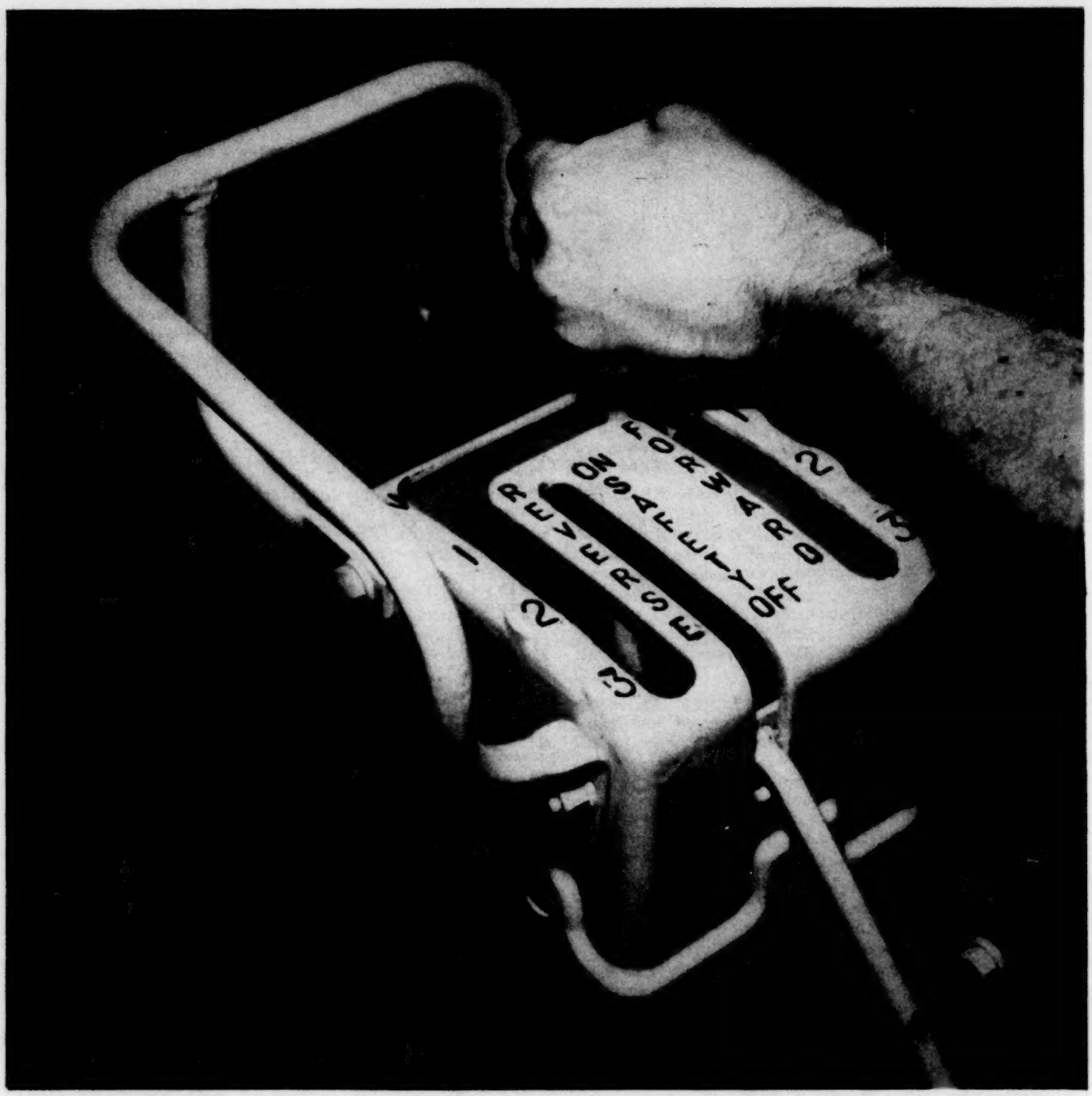

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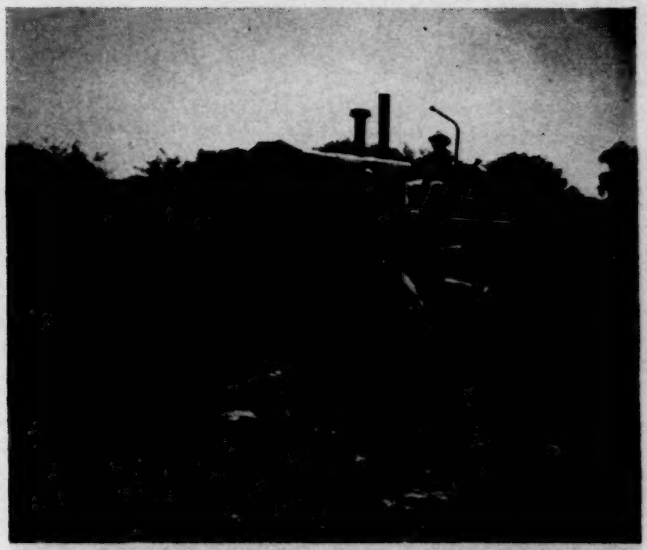

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# SOCIETY BUILDING FUND GROWS!

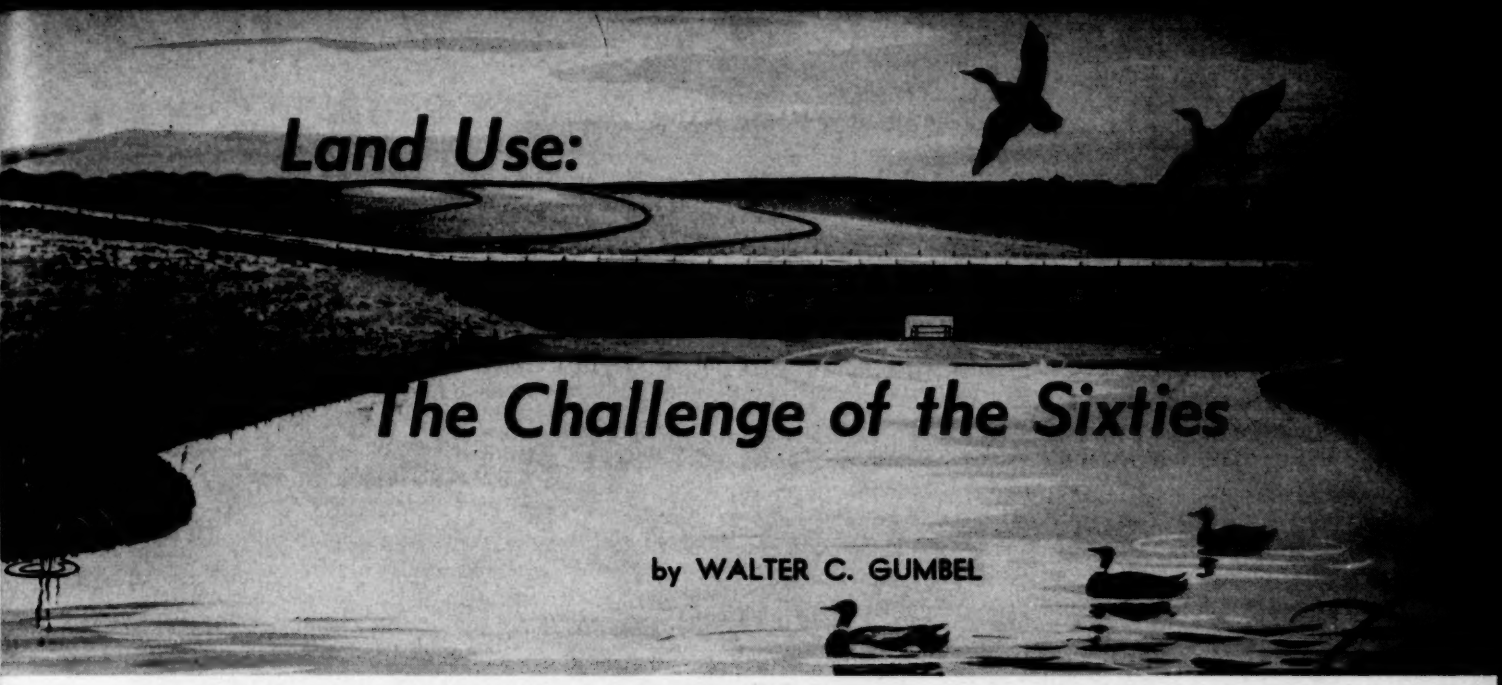
▶ *Growth of the building fund was reported in each issue of the Journal during 1961: January —$18,341.47; March—$22,998.00; May—$28,518.98; July—$40,468.56; September—$54,420.14; November—$62,466.46. Have you been a part of this growth?*

▶ *The Honor Roll of Chapters now includes: Central Arkansas, Ozark Mountain, Iowa, New Jersey, William Penn, Heart of Texas, Ark River Bend, West Virginia, East Texas, and Washington, D. C. Members of these chapters have each contributed an average of at least $10.00 toward the permanent home for the Society.*

## October 31, 1961 — Report

| Chapter | Chapter Pledge | Paid to Date | Building Fund Committee Organized |
|---|---|---|---|
| **Great Plains Region** | | | |
| El Paso County *(Colo.)* | $ 250 | $ 380.00 | |
| Ark River Bend *(Kans.)* | 320 | 320.00 | (1) |
| Bluestem Hills *(Kans.)* | | 31.00 | |
| Bob White *(Kans.)* | 145 | 165.00 | (1) |
| Fort Hays *(Kans.)* | | 24.00 | (1) |
| High Plains *(Kans.)* | | 51.65 | |
| Manhattan *(Kans.)* | 1,000 | 408.00 | (1) |
| Pony Express *(Kans.)* | | 169.39 | (1) |
| Salina *(Kans.)* | | 170.50 | (1) |
| Santa Fe Trail *(Kans.)* | | 26.00 | |
| Southwest Kansas | | 19.00 | |
| Bozeman *(Mont.)* | | 84.00 | |
| Blue-Nemaha *(Nebr.)* | | 10.00 | (1) |
| Lincoln *(Nebr.)* | | 592.50 | (1) |
| Nebraska Panhandle | | 40.25 | (1) |
| Nebraska Sand Hills | | 11.00 | (1) |
| Northeast Nebraska | 125 | 45.50 | (1) |
| S. C. Nebraska | | 267.03 | (1) |
| Southwest Nebraska | | 73.90 | |
| Rio Grande *(N. Mex.)* | 75 | 202.00 | |
| Custer *(N. Dak.)* | | 397.98 | |
| Big Hunt *(Okla.)* | | 77.25 | (1) |
| Central Oklahoma | | 125.00 | |
| E. C. Oklahoma | | 147.25 | |
| N. E. Oklahoma | | 179.32 | |
| Northwest Oklahoma | | 9.00 | |
| S. C. Oklahoma | 100 | 68.00 | |
| Southeast Oklahoma | | 23.50 | |
| Southwest Oklahoma | | 293.00 | (1) |
| Stillwater *(Okla.)* | | 275.50 | (1) |
| South Dakota | | 1,219.25 | |
| East Texas | 442 | 327.50 | (1) |
| Heart of Texas | | 784.41 | (1) |
| North Texas | 50 | 285.50 | (1) |
| N. C. Texas | 50 | | |
| Wyoming | | 136.00 | |
| TOTAL—Great Plains Region | $ 2,557 | $ 7,433.18 | 18 |
| **North Central Region** | | | |
| Egyptian *(Ill.)* | 250 | 148.00 | (1) |
| Northern Illinois | 3,000 | 1,911.20 | (1) |
| Hoosier *(Ind.)* | | 1,469.73 | (1) |
| Iowa | 7,500 | 5,222.69 | (1) |
| Blue Grass *(Ky.)* | | 203.00 | (1) |
| Green River *(Ky.)* | | 60.00 | (1) |
| Hugh Bennett *(Ky.)* | | 70.00 | (1) |
| Kentucky Lake | 250 | 175.50 | (1) |
| Lake Cumberland *(Ky.)* | | 35.00 | |
| Limestone *(Ky.)* | | 10.00 | |
| Northeastern Kentucky | | 18.00 | |
| Northern Kentucky | | 40.00 | |
| Upper Kentucky River *(Ky.)* | | 80.00 | |
| Michigan | 2,500 | 866.92 | (1) |
| Minnesota | 1,600 | 641.25 | (1) |
| Show-Me *(Mo.)* | | 318.50 | |
| All Ohio | 1,000 | 599.00 | (1) |
| Wisconsin | 2,400 | 630.50 | (1) |
| TOTAL—N. C. Region | $18,500 | $12,499.29 | 12 |
| **Northeastern Region** | | | |
| S. New England *(Conn.-Mass.-R.I.)* | | 156.00 | (1) |
| Washington, D. C. | 5,000 | 2,664.92 | (1) |
| N. New England *(Maine-N.H.-Vt.)* | 1,480 | 388.50 | (1) |
| Old Line *(Md.)* | 1,500 | 574.00 | (1) |
| Pocomoke *(Md.)* | | 100.00 | (1) |
| New Jersey | 1,250 | 1,459.00 | (1) |
| Empire State *(N.Y.)* | 2,000 | 1,413.08 | (1) |
| Keystone *(Pa.)* | 1,000 | 304.00 | (1) |
| Wm. Penn *(Pa.-Del.)* | 400 | 563.50 | (1) |
| Virginia | 2,500 | 988.25 | (1) |
| West Virginia | 3,000 | 3,000.00 | (1) |
| TOTAL—N. E. Region | $18,130 | $11,611.25 | 11 |
| **Southeastern Region** | | | |
| North Alabama | | 200.00 | (1) |
| South Alabama | | 575.50 | (1) |
| Central Arkansas | 800 | 1,159.22 | (1) |
| Ozark Mt. *(Ark.)* | | 463.00 | (1) |
| Florida | 890 | 513.48 | (1) |
| Georgia | 5,000 | 838.00 | (1) |
| Louisiana | | 170.00 | (1) |
| Mississippi | 1,000 | 124.50 | (1) |
| North Carolina | 5,000 | 747.25 | (1) |
| San Juan *(P.R.)* | 500 | 142.00 | |
| Western Puerto Rico | | 56.50 | |
| South Carolina | 795 | 565.55 | |
| Andrew Jackson *(Tenn.)* | 1,000 | 669.50 | (1) |
| East Tennessee | 900 | 202.00 | (1) |
| West Tennessee | 570 | 242.75 | (1) |
| TOTAL—S. E. Region | $16,455 | $ 6,669.25 | 12 |
| **Western Region** | | | |
| Arizona | | 233.00 | (1) |
| California | 3,500 | 2,131.25 | (1) |
| R. N. Irving *(Idaho)* | | 140.50 | (1) |
| Nevada | | 27.00 | |
| Oregon | | 110.50 | (1) |
| Utah | | 181.50 | (1) |
| Inland Empire *(Wash.-Idaho)* | | 369.50 | (1) |
| Olympic View *(Wash.)* | | 36.50 | (1) |
| TOTAL—Western Region | $ 3,500 | $ 3,229.75 | 7 |
| **Canadian Region** | | | |
| Ontario | 1,600 | 1,340.00 | |
| **Other Contributions** | | | |
| Korea | | 20.00 | (1) |
| No Chapter Designated | | 591.50 | |
| Development Fund Board Special Solicitation | | 3,092.50 | |
| Des Moines Fund Drive | | 8,465.00 | |
| Transfer of Funds | | 3,870.00 | |
| Contract Pledges[1] | | 3,000.00 | |
| TOTAL | $60,742 | $61,821.72 | 60 |
| Interest earned | | $ 644.74 | |
| **GRAND TOTAL** | | **$62,466.46** | |

[1] To be paid upon letting of contract



# Land Use:

# The Challenge of the Sixties

by WALTER C. GUMBEL

***In the United States and Canada there is a general abundance of natural resources. The use and development of them is reflected in an enterprising agriculture and in strong industrial centers. New scientific discoveries and advances in technology have enabled Americans to increase their outputs of goods and services far beyond that of most nations. But these developments have created many land use problems that are affecting vital segments of our economic, social and political system.***

IT HAS OFTEN BEEN SAID that the story of land is the story of man. Certainly they are inseparable. History records the rise and fall of great civilizations because people neglected to care for the land and the waters. Even today, in areas like the Middle East and other parts of the world where highly developed societies once flourished, the situation is no different than it was before man carelessly squandered his natural resources. Standards of living in these areas are low today because it requires a constant effort by everyone to produce the basic necessities of life from impoverished or underdeveloped land. There is, however, one great change: Populations have increased and the scant supplies of available food and water must be shared. These conditions have created serious social and political problems for which reasonable solutions must be found. Some of these problems have international implications and are presently the source of friction between nations.

In Latin America, natural resources, although abundant, have not been fully utilized or developed to meet the needs of growing populations. Hunger and unrest have created social and political problems that could well threaten freedom throughout the world. Land use and agricultural programs designed to help lay the foundations of self-sustaining economies are badly needed. These are matters of grave importance that concern all of us.

There is no more important problem confronting our country than that of matching renewable natural resources with the needs of man. Consequently, our interest concerns the wise use and development of the land and its soils, water, grass, forests, wildlife, and aesthetic and recreation values as they relate to the present and future production requirements of agriculture and the resource needs of industry and urban people. We need to know something about the present structure of agri-

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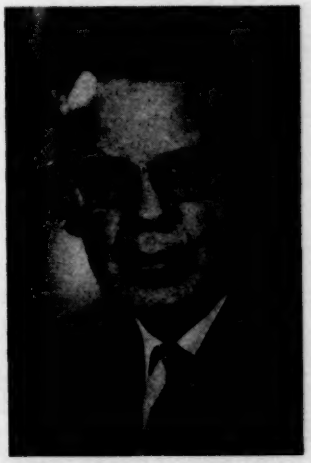

*Walter C. Gumbel, of Fairmont, West Virginia, is President of the Soil Conservation Society of America. A charter member of the Society, he served as editor of the Journal for 10 years.*

*This article is taken from Mr. Gumbel's keynote address on July 30, 1961, at the opening session of the Society's Sixteenth Annual Meeting.*

*The figure of Blackman Dam on Mule Creek Pilot Watershed in Iowa at the top of this page is from a well-known sketch by the talented artist, Felix Summers.*

culture— its changing pattern, its capacity to produce and the availability of land. Without this knowledge, our land use and soil conservation efforts would have little meaning.

### The Productive Capacity of Land is Great

Many forecasts have been made to show the expected economic growth of the nation during the next 25 years or more. Some of these estimations are reasonably accurate while others are misleading and confusing. The fact remains, however, that programs generally must be planned to meet the needs resulting from projected population increases and changes brought about by new technologies. The nation's agricultural plant, including its land use and soil conservation requirements, is no exception.

Reliable forecasts indicate that the present United States population of 183 million persons will increase by about 3 million people annually. Also important is the fact that the nation's 4.5 million farms and ranches will continue to decline in number, and units will become larger. Part-time farms, on the other hand, will generally lose their identity and either be combined into larger units or be diverted to other uses. Farming operations may also be expected to change as scientific discoveries are revealed.

In this connection, we are told that less than an 8 percent increase in farm output above 1959 levels will be required to meet future needs for farm products at home and abroad up to 1965. It could be even less if current surplus stocks were utilized.

The present and projected changes in land use are of vital significance to the conservationist. These changes are clearly shown in a recent report issued by the Agricultural Research Service. This study shows that in 1959, more than 70 percent of the nation's 1.9 billion acres of land was available for production of crops and livestock. Land in crops and cropland pasture totaled 460 million acres. Another 630 million acres of open pasture land and 270 million acres of forest and woodland were used for grazing livestock.

The report also shows that a much larger acreage could be planted to crops. There are now about 110 million acres of grassland and 105 million acres of woodland that are fairly well adapted for use as cropland. But 40 to 50 million acres now in crops are not physically well adapted to this use. This means that 170 million additional acres could be used as cropland when needed. A more immediate supply of cropland, however, exists in the 28.7 million acres now in the Conservation Reserve.

This brief appraisal of the nation's pattern of agricultural land use indicates that there is no immediate danger of a land shortage. The total production of farm crops is running about 5 percent ahead of consumption. Obviously, we are in a period of relative abundance. The picture can and undoubtedly will change within the next 15 to 25 years when the demand for farm products will be materially greater.

In light of these circumstances, there are some who feel that land use and soil conservation programs are no longer necessary. This, in my judgment, is a false and dangerously unwarranted conclusion. In a sense, it reflects a phase of the political environment for soil conservation. We cannot ignore the problem of surpluses nor can we relax our conservation efforts for even a moment. Even though new technologies may be expected to increase the productive capacity of the land, who knows when a crop failure or a catastrophe short of war may strike? We are losing annually some 400,000 acres of cropland through erosion and 1.5 million acres through conversion to non-agricultural uses. Soil deterioration through heavy cropping is also an increasingly serious problem. Sediment, the product of erosion, continues to pollute our streams and adds greatly to the nation's flood damages. Many other significant problems point out the necessity for action programs in soil conservation.

In the past, soil conservation programs were generally sold to farmers and ranchers on the basis of soil loss prevention. The emphasis is now shifting to the effect conservation practices, or lack of them, have on a farmer's income, including his total investment.

### Land Use: A Problem in Depressed Areas

Ordinarily we think in terms of conservation programs that deal with land use and supporting practices on individual farms and ranches. However, the Great Plains Conservation Program and the Watershed Protection and Flood Prevention Program are designed to correct specific land use and related resource problems that extend far beyond farm and ranch boundaries. But, there are other important land use problems, some of local significance and others involving areas in several states.

The problem of low farm income in the nation's depressed or underdeveloped areas is of particular import. These areas are widely scattered and generally located where the topography is rugged and natural resources have been depleted. The usual reasons for the existence of depressed areas are the decline of one or more major sources of employment, depletion of the source of industrial raw materials, changes in the structure of agriculture, and the unwillingness or inability of the unemployed to seek work elsewhere.

Congress has enacted legislation to help these areas locate new industries, re-train workers, and generally assist with programs that pertain to urban and industrial development. These are essential needs; fulfilling them helps provide income within a reasonable period to destitute families.

**A modern highway cuts a wide swath through the heart of a residential and business area of a large city. This expensive shift in land use exemplifies the problem of urban demand for more land as people decide that additional resources should be devoted to transportation systems.** *Des Moines Register and Tribune Photo*

One aspect of the distressed area problem is of interest to the conservationist. A large percentage of the farmers in these areas depend upon off-farm employment to supplement their income for the farms provide extremely low returns. The regions in which these farms are located are usually mountainous or hilly or the soils are shallow. Originally, most of these lands were covered with fine stands of timber. Game and fish were also abundant. After the early exploitation of these resources, settlers followed and cleared the land to produce food and provide pasture for livestock. Their poor land management practices, which extended over a long period of time, caused the soil to erode and become badly depleted, thereby contributing to the frequency of floods, low stream flow and sediment damage to downstream areas.

These lands are generally confined to physical areas like the Appalachians and Ozarks but similar, though smaller, areas may be found in most states. Land capability studies show that these lands may be best suited for timber, wildlife and recreation, grazing and special farm crop enterprises, and as the source of water for downstream urban and industrial centers. Long-time land use goals such as these do not contribute to the immediate needs of low income farmers. The solution of the land use problem in distressed areas must be correlated with employment and development programs in urban and industrial areas.

Rural development programs usually attempt to solve this problem on a piecemeal basis. A few instances have been reported where the introduction of new industries has provided some off-farm employment. This is desirable. The long time solution, however, is dependent upon the development of a regional land use pattern which is in keeping with the capability of the land and the physical, social and economic resource needs of all the people.

### Industrial and Urban Land Use Problems

Those of us who travel or work in certain areas have seen the effects of open-cut or strip mining on the landscape. Not only are these operations changing existing land use patterns of entire communities, but they are also creating wide concern over their adverse effects on off-site land and sources of water, particularly in areas where land restoration programs are difficult to achieve.

Strip mining for coal, iron ore, copper, sand and gravel, and other raw materials has been underway for many years in more than 30 states. These materials are important to the nation's industrial economy. State laws require mine operators to restore and revegetate the affected lands. In most cases the result of such efforts have been highly successful. There are areas, however, where progress has been slow.

Reclamation programs on these lands are difficult to establish and often present problems of a technical nature. For this reason the *Society* has established a technical study committee on Mined Area Restoration to inform the membership of the extent of this work, its effect on land use and water resources, and the best restoration methods that are now being used. This committee is also to determine what technical standards could be established that would reasonably safeguard land and water values.

The nation's changing agricultural pattern is also reflected in the development of urban areas. In the United States, 78 percent of the population lives in the cities. Parts of Canada are also experiencing this trend toward urbanization.

This development raises many questions. How can proper land use and conservation planning contribute to a more orderly urban expansion? What are the effects of urbanization on adjoining agricultural lands and water resources? What educational mechanisms are needed to help obtain a better understanding of urban land use and resource needs by both urban and rural interests? As urban population increases, land use problems will become more complex and difficult to handle. An area or regional land use pattern in keeping with urban and industrial requirements is long overdue.

In this connection, the nation's land requirements for modern highways, airports, reservoir sites, defense needs, outdoor recreation, areas for hunting and fishing, and other public and private uses, will increase from year to year as population grows. Already, more than 1.5 million acres are being diverted to these uses each year. These conversions have not always followed the pattern of proper land use, nor will they, until there is public understanding and public demand that they should.

### Demand for Water and Forest Products

The nation's water requirements are now at an all-time high and projections show that they will increase tremendously. Our supply of water is relatively fixed and we are plagued by problems of quality and distribution. Future water shortages or surpluses could well determine the agricultural pattern of an area or even a region, and the supply as well as the quality of water available will determine industrial and urban development.

Programs designed to abate industrial and municipal wastes and silting from farm lands in the nation's streams are as important to the conservationist as they are to urban and industrial planners.

Weather studies by means of space satellites are now being made. This highly important development will undoubtedly improve forecasting techniques and may eventually lead to management of weather and control of rainfall by man.

The nation's forests and small farm woodlands, in public or private ownership, will also be affected by the nation's growing economy. The demand for wood products is expected to increase and large acreages are already being converted to parks, power line lanes, highways, and urban and industrial uses. Conversion of forest land to these uses has been averaging less than 1 million acres annually but it could reach a dangerously high figure in future years. However, it is estimated that there are 40 to 50 million acres now in cropland that is better suited for grazing and growing timber. On the other hand, there are 105 million acres in forest land that could be used for producing food and fiber should the need ever arise.

Major land conversions to forests may be expected to occur in the nation's low farm income regions. This is basically a matter of proper land use adjustment. Equally important is the need for placing greater emphasis on improved woodland management and wood utilization programs. Protection of all forests against fire, insects, and disease, and adoption of the multiple use concept now being implemented on some private and public lands are vital to good land use.

Land use in our changing agriculture represents many diverse resource interests and needs. Each land use should serve a definite purpose in helping the nation and the free world meet human requirements. However, resource development programs are generally designed to achieve a single goal. Some, of course, have been broadened. Yet, the fact remains that the total national resource program must be based on land and on its proper use. Such a program must be economically sound and morally right.

### Guiding Land Use Adjustments

The mounting pressures for more water, more land for recreation, more reservoir sites, better highways and more space for cities, along with other unforeseen requirements, unless properly planned and coordinated, will add to the nation's social and economic problems. Adjustments in land use will be more expensive the longer we wait, and meanwhile improper uses continue to create new problems. Change will come whether we like it or not; the question of the hour is: Are we ready to consider and give leadership to the development of a nationwide coordinated land use and conservation program? My answer is an emphatic yes! The *Soil Conservation Society of America* stands ready to lend counsel and guidance in the decision making process and to implement these decisions with effective action.

We believe that the task before us is to identify the nation's present and future land use and resource needs in such a way that they will have public acceptance and become the basis of public policy. These needs must be

**Though agricultural production is currently adequate, soil conservation efforts cannot be relaxed. These parallel cut and fill terraces, permitting the use of 4 and 8 row equipment and obviating many point rows, are examples of new soil and water conservation technology that must be applied if the soil is to remain highly productive and the rivers and streams free of silt.** *SCS Photo*

generally understood by all people; they must be reasonable and provide for the physical wants of man; they must be compatible with other goals desired by man; they must fit into our social, economic and political pattern of society; and above all, they must be dynamic.

To achieve this principal goal and others of equal importance, the *Soil Conservation Society of America* has been actively engaged in a series of technical studies, each dealing with a phase of the total land use and conservation needs of the nation. The study areas include land utilization, water resources management, land zoning, outdoor recreation, urban-suburban conservation problems, mined area restoration, research, international relations, conservation education and professional training. On each committe are individuals highly trained in a variety of disciplines; they represent various state and federal resource agencies and private enterprise groups. This human reservoir of professional and technical knowledge and experience relating to land use represents a unique asset which cannot be matched by any other group in the nation. As the work of these and other committees is reported, it will form the basis of the *Society's* general position on land use and present the technical requirements for implementing action programs in each specific area.

I do not want to leave the impression that other groups are not cognizant of the nation's changing land use and resource needs pattern. Many have made and are making notable contributions, but most are dealing with a single resource or land use. The ultimate task is great and much broader in scope; it will require the combined efforts of professional conservationists, agricultural leaders, colleges and universities, resource leaders representing industry and trade groups, and the public. Conflicts and jealousies between agencies of government must be reduced to a minimum. The attitude of land owners and private enterprise groups must become more responsive to resource use for the public welfare. Too often we fail to recognize that these groups have developed strong position statements and programs supporting the wise use and development of the nation's resources. Their leadership is well informed and is needed to give balance so that programs can be designed within the framework of the American system of free enterprise.

In a sense we are at the beginning of a decisive period in our national land use and conservation efforts. The fact that properly developed soil conservation and agricultural programs are economically sound and in the best interests of society needs to be presented to the nation and its leaders in all walks of life. Too often, information presented to the public through popular news media has been badly misinterpreted. Since these matters concern all of us, it is extremely important that the complete story be correctly told. This presents a tremendous challenge. To accomplish this goal, a nationwide public relations program has been proposed. This proposal is now being jointly considered by the *Society* with industrial and business leaders and trade groups who are closely allied with agriculture and natural resource interests. The major responsibility for a program of this kind must be assumed by persons other than professional workers. Also being considered is a national

resources meeting and workshop designed to evaluate existing and emerging agricultural and resource programs, as well as the cooperative role that must be played by professional workers and private enterprise interests in program implementation.

### Assistance In Latin America

Because of worldwide influences and tensions, it has become increasingly apparent that conservationists working in the field of land use and resource development must become more active in helping to improve the living standards of underdeveloped countries. This involves a variety of programs—land use, the production of crops, industrial development, education, and a host of others. It is an urgent task. People in these countries know that it is possible for them to live more decent and satisfying lives. They do not want to wait to eliminate their poverty, ignorance and chronic ill health.

Our nation's technical assistance programs have been extended to most nations of the world. However, recent reports indicate that some of these programs need to be greatly expanded, particularly in Latin America.

It would seem that the *Soil Conservation Society of America* should also think in terms of offering its professional and technical skills to help its members in Latin America find solutions to existing land use and related natural resource problems. A task force, properly organized and financed, could be highly effective. This would not detract from our interest in technical assistance programs to other nations, but anything the *Society* can do to help our neighbors "south of the border" should have a high priority. It is interesting to note that leading trade organizations and some of the nation's technical engineering societies have already initiated cooperative assistance programs. This approach is striking for it provides the opportunity for persons at comparable levels to join together freely in seeking solutions to difficult and perplexing problems with which the people directly affected are unable to cope.

### People Must Understand the Need

In our search for answers to the nation's perplexing land use and agricultural problems, we need to keep in mind that now, more than ever before, we are on the threshold of unparalleled scientific and technological discoveries in the physical, social, economic and political sciences. These developments along with an ever-increasing population will create new pressures, thereby adding new dimensions to the nation's many difficult land use and resource problems.

It is now relatively clear that our agricultural and conservation efforts must be redirected toward a unified land use program. Our piecemeal approach must give way to coordination of efforts by all interests. Let us not delude ourselves about the facts of the matter. Land and water resources are generally fixed, while the economic, social, physical and political needs of man are changing. These are basic considerations which give substance to the American way of life, strength to our free political and social institutions, support to our vast industrial system, and meaning to our plans for national security.

The task before us is not an easy one. There are those who resist change but others are ready to move ahead through social planning. The conservationist can play an important role in the planning and decision making process. He is supported by many disciplines and knows that a national land use program must be based on technical fact—not ideologies. He is, therefore, a key individual. There are other well qualified persons who also are prepared to help. They may be found in the nation's colleges and universities, industrial groups, agencies of state and federal government, technical societies, and soil conservation districts. These forces represent valuable assets in our effort to impress upon all people that the solution of local, regional and national resource problems must be predicated on a land use program that is in proper context with their environmental needs. To implement an action program I urge the *Society* begin immediately to:

**1** Develop a national land use guideline statement that in simple language details the principle objectives and goals desired.

**2** Establish a public relations and an educational program to keep the nation informed of its resource conservation and agricultural achievements, as well as the problems and future requirements in these areas.

**3** Consider the establishment of a 100-man committee to study land use development. Such a group would represent every major segment of the economy in the United States and Canada.

**4** Encourage colleges and universities to speed up the training of men and women working in the areas of resource management.

**5** Ask the states, provinces, and regional areas to initiate or speed up local land use studies and plans.

**6** Encourage technical societies, trade organizations, agencies of government and others having resource use interests to reorient their policy or position statements toward the attainment of a basic land use program.

This may appear to be an overwhelming program. The fact remains, however, that the nation's land use problems will never be solved unless people understand the need and are asked to join in making the decisions.

Abraham Lincoln said, "You can't escape the responsibility of tomorrow by evading it today." A century later our interpretation of his statement clearly becomes, "Land Use: the Challenge of the Sixties."

# Effect of Cover and Soils on Surface Runoff

NEAL E. MINSHALL

*A change in the amount of area cultivated in a watershed has a considerable influence on storm runoff from moderately permeable silt loams but only a minor effect on claypan soils. This article presents the results of investigations of the effects of vegetative cover on runoff and shows how these effects differ on two soil types—the Upper Mississippi Loess Hills soils of the experimental watersheds near Fennimore, Wisconsin, and the Claypan Prairie soils of the experimental watersheds near Edwardsville, Illinois.*

A SERIES OF FOUR WATERSHEDS (table 1) near Fennimore, Wisconsin, were selected for study by the Soil Conservation Service Research in cooperation with the Wisconsin Agricultural Experiment Station in 1938.[1] The three smaller watersheds lie entirely within the larger 330-acre watershed located in the unglaciated section of southwestern Wisconsin. The soils are moderately permeable silt loams of loessial origin and are underlain with limestone at depths of more than 4 feet over most of the area.[2] These soils are included in the Soil Conservation Service's classification system under hydrologic group B.

Records have been kept for 22 years of the precipitation, runoff, temperature, humidity, and cover conditions on these watersheds. Continuous records of runoff were obtained by water level recorders located above precalibrated weirs. Soils, topography, climate, and cropping practices on these watersheds are typical of those in parts of northeastern Iowa, northwestern Illinois, southeastern Minnesota, and southwestern Wisconsin.

### Cover Conditions on Fennimore Watersheds

All watersheds at Fennimore, Wisconsin, except the 22.8-acre area, were in mixed cover for the entire 22-year period of record. Table 2 shows the crop cover on these watersheds for those periods having appreciable amounts of storm runoff.

When evaluating the effect of crop cover on runoff, the season when runoff-producing storms occur should be considered. Records of plot runoff at the Upper Mississippi Valley Conservation Experiment Station near La-Crosse, Wisconsin, indicate that the second year of crop rotation, which is normally small grain following corn and seeded to clover or alfalfa, causes as much or more runoff as corn during the period from May to mid-July. Later, from mid-July to late fall, when the new seeding has developed a good cover, it will yield only the same amount of surface runoff as expected from good hay or pasture. This is a gradual transition and the date of completion varies according to whether the season is advanced or retarded and upon the availability of enough moisture to produce a good stand of new seeding. These limitations have been taken into account in this analysis of storm runoff data.

TABLE 1
Characteristics of the Experimental Watersheds Fennimore, Wisconsin.

| Watershed Number | W-1 | W-2 | W-3 | W-4 |
|---|---|---|---|---|
| Drainage Area *acres* | 330 | 22.8 | 52.5 | 171 |
| Range in Elevation | 1105 | 1158 | 1124 | 1146 |
| *feet* | 1247 | 1212 | 1211 | 1247 |
| Prevailing Land Slopes *percent* | 4 & 8 | 4 & 8 | 4 & 10 | 4 & 7 |
| Average Waterway Slope *percent* | 1.8 | 5.0 | 3.5 | 2.2 |
| Soils: *percent of area* | | | | |
| Tama silt loam | 50 | 73 | 34 | 70 |
| Dodgeville silt loam | 23 | 25 | | 24 |
| Dubuque silt loam | 19 | | 61 | |
| Judson silt loam | 8 | 2 | 5 | 6 |
| Land Capability: *percent of area* | | | | |
| Class II | 45 | 65 | 39 | 62 |
| Class III | 32 | 35 | 34 | 28 |
| Class IV | 17 | | 27 | 7 |
| Class VI | 6 | | | 3 |
| Recording Rain Gauges *No.* | 9 | 1 | 2 | 4 |

### Effect of Cover Changes on Seasonal Runoff

Watersheds W-2 (22.8 acres) and W-4 (171 acres) at Fennimore, Wisconsin, were selected for a comparison of effects of cover on total May through October runoff because these two areas are similar in shape, soils, and topography. Figure 1 is a double-mass plotting of the May-October accumulated runoff for these two watersheds. Except for 1944-45 and 1950-52, the summer runoff on W-2 was never more than half as much as that

[1] This research has been conducted by the Agricultural Research Service since the USDA reorganization in 1954.

[2] For a more detailed description of these watersheds see: Neal E. Minshall. 1949. *Rates of runoff for the design of conservation structures in the Upper Mississippi Valley upland loessial areas.* SCS-TP-73. U. S. Dept. Agr., Washington, D. C. 30 pp., illus.

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*Part of the material included in this paper was presented at an annual meeting of the American Society of Agricultural Engineers but was never published.*

TABLE 2

Crop Cover[1] During Storm Periods, Experimental Watersheds, Fennimore, Wisconsin

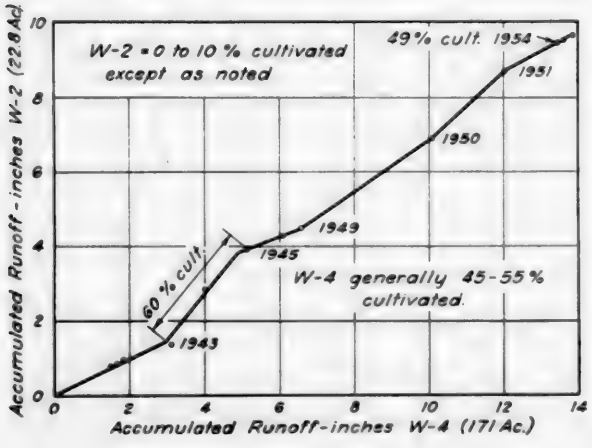
| Date of Storm | | Watershed 1 330 Acres | | Watershed 2 22.8 Acres | | Watershed 3 52.5 Acres | | Watershed 4 171 Acres | |
|---|---|---|---|---|---|---|---|---|---|
| | | Hay Pasture Roads Bldgs. | Cultivated | Permanent Hay or Pasture | Cultivated | Hay Pasture Roads Bldgs. | Cultivated | Hay Pasture Roads Bldgs. | Cultivated |
| | | percent | percent | percent | percent | percent | percent | percent | percent |
| September | 1938 | 63.3 | 36.7 | 93.1 | 6.9 | 62.3 | 37.7 | 55.1 | 44.9 |
| July-August | 1940 | 73.1 | 26.9 | 76.5 | 23.5 | 68.2 | 31.8 | 73.5 | 26.5 |
| May | 1941 | 59.3 | 40.7 | 61.6 | 38.4 | 49.4 | 50.6 | 54.0 | 46.0 |
| September | 1942 | 77.7 | 22.3 | 93.6 | 6.4 | 90.0 | 10.0 | 73.1 | 26.9 |
| June | 1943 | 59.9 | 40.1 | 73.1 | 26.9 | 72.9 | 27.1 | 53.5 | 46.5 |
| August | 1943 | 70.0 | 30.0 | 76.0 | 24.0 | 72.9 | 27.1 | 65.4 | 34.6 |
| June-July | 1944 | 50.0 | 50.0 | 40.8 | 59.2 | 59.6 | 40.4 | 41.9 | 58.1 |
| June | 1945 | 45.5 | 54.5 | 38.3 | 61.7 | 50.6 | 49.4 | 41.1 | 58.9 |
| June | 1947 | 68.3 | 31.7 | 90.8 | 9.2 | 85.1 | 14.9 | 56.1 | 43.9 |
| June | 1949 | 52.3 | 47.7 | 90.8 | 9.2 | 66.2 | 33.8 | 44.6 | 55.4 |
| July | 1950 | 65.6 | 34.4 | 100.0 | 0 | 71.0 | 29.0 | 54.6 | 45.4 |
| July | 1951 | 66.4 | 33.6 | 100.0 | 0 | 71.0 | 29.0 | 58.5 | 41.5 |
| August | 1951 | 78.6 | 21.4 | 100.0 | 0 | 96.6 | 3.4 | 72.0 | 28.0 |
| June | 1954 | 55.0 | 45.0 | 51.0 | 49.0 | 51.0 | 49.0 | 50.5 | 49.5 |

[1] Grain seeded to alfalfa or clover was considered as cultivated up to mid-July and as hay for the rest of the growing season

on W-4. During the summers of 1944 and 1945 the runoff from W-2, then 60 percent cultivated, was 28 percent higher than from W-4. The runoff totals for these 2 years resulted from a number of small storms. Runoff in 1950 and 1951 was the result of one large storm each year, and even with the smaller area (W-2) 90 percent in hay, the runoff from it was 77 percent as much as from W-4 (171 acres) which was over 50 percent cultivated. A change in cover can cause large variations in runoff during small storms, but in major flood-producing storms a marked reduction in cultivated area will ordinarily

Runoff from W-2 was only half that from W-4 for the one storm which occurred on June 21, 1954, although both watersheds had 50 percent of their areas in cultivation. The reason for this is that a good sod, developed over a 6-year period on W-2, was plowed under for the first year cultivation in 1953 and had not completely decomposed. The 1954 plowing returned this sod material to the surface to act as a mulch. Except for the corn field on this sod material which gave no visible evidence of washing, erosion losses were heavy on all corn fields during this 1954 storm.

Figure 1. Comparison of accumulated total May through October runoff, 1940-1959, from experimental watersheds 2 and 4, Fennimore, Wisconsin.




## Effect of Cover on Single Storm Runoff

The storm pattern and antecedent moisture conditions must be taken into consideration when studying the runoff from individual storms.

Since the infiltration rate decreases as the storm progresses, the advanced type of storm (highest intensities at the beginning) will cause less runoff than an equal amount of precipitation in a retarded type storm (highest intensities near the end). To eliminate the effect of storm pattern in this analysis, all comparisons were limited to identical storms on adjacent watersheds.

It is often difficult to make direct comparisons of runoff between two areas for individual storms because of variations in rainfall. It is frequently advantageous to compare amounts of retention rather than runoff. Retention, as referred to here, is precipitation minus surface runoff and includes plant interception, depression storage and infiltration. Table 3 gives data on precipitation, runoff and retention for a number of summer storms at Fennimore, Wisconsin, during which the intensity was high enough to cause runoff from all areas. The precipitation amounts shown are for that portion of the storm which caused runoff and do not include amounts either before or after this intense period when the rainfall intensity was below infiltration capacity. Note that the retention for the two largest watersheds is similar for all storms.

The method of analysis for these individual storms is illustrated in figure 2. The storm runoff data from table 3 are grouped according to percent of area cultivated (see table 2) and the retention on two areas compared. Figure 2 shows the comparison of retention on Watershed W-1 (330 acres) with that on W-2 (22.8 acres) for storms occurring during different combinations of cover i.e., W-1, 22 and 36 percent cultivated vs. W-2, 0 to 6 percent; W-1, 50 to 55 percent cultivated vs. W-2,

60 percent; and W-1, 45 percent cultivated vs. W-2, 49 percent. It should be noted that the storm of June 21, 1954, represents a special case. Based on percentage of area cultivated, this storm, which should have lined up with the points shown for 1944 and 1945, actually shows proportionally more retention for W-2 (49 percent cultivated) than when the area was 100 percent hay in 1950. The reason is that a good heavy sod, developed over a 6-year period, was plowed under in 1953 and it had not completely decomposed when it was returned to the surface by plowing in 1954. This partially decomposed material acted as a mulch and the runoff values did not actually represent a cultivated field. Therefore, the storm period of June 21, 1954, could not be used in this analysis. The equations of the lines representing each of the other cover combinations are shown. In these equations, $Y$ is the retention on W-1 and $X$ the retention on W-2, and since retention is precipitation minus runoff, $Y=P_1-Q_1$ and $X=P_2-Q_2$ where $P$=precipitation, $Q$=runoff, and the subscript denotes the watershed number.

To estimate the effect on runoff of a reduction in cultivated area on W-1 from 36 to 22 percent requires use of the equation for each of these conditions when they are to be compared with W-2 which was 0 to 6 percent cultivated.

These equations are:

$Y=1.018X-.06$ for W-1 22 percent cultivated

$Y=.904X-.06$ for W-1 36 percent cultivated

Substituting $P$ and $Q$ for $Y$ and $X$ in the first equation and solving for $Q_1$ gives:

$$Q_1=P_1-1.018P_2+1.018Q_2+.06$$

Using this equation and values of $P_1$, $P_2$ and $Q_2$ from table 3, runoff $Q_1$, assuming W-1 to be 22 percent cultivated, was computed for each of the storms in the table. Values of $Q_1$ for W-1, 36 percent cultivated, were obtained in a similar manner. The data for these two conditions were then plotted as shown in figure 3 from which, knowing the runoff on W-1 for either 36 or 22 percent cultivated, values for the other conditions can be obtained.

### Description of Edwardsville Watersheds

Three small watersheds (table 4) located about 5 miles northeast of Edwardsville, Illinois, were established in March 1938 by the Soil Conservation Service Research in cooperation with the Illinois Agricultural Experiment Station. The two smaller watersheds lie entirely within the larger 290-acre watershed. The soils on these areas are of loessial origin. Deposited over glacial till they have an impervious claypan layer at depths of 10

TABLE 3

Comparative Data on Precipitation, Runoff and Retention for Selected Storms, Experimental Watershed, Fennimore, Wisconsin.

| Date of Storm | Duration | Excessive Precipitation | | | | Runoff | | | | Retention | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | W-1 330 A. | W-2 22.8 A. | W-3 52.5 A. | W-4 171 A. | W-1 330 A. | W-2 22.8 A. | W-3 52.5 A. | W-4 171 A. | W-1 330 A. | W-2 22.8 A. | W-3 52.5 A. | W-4 171 A. |
| | minutes | $P_1$ inches | $P_2$ inches | $P_3$ inches | $P_4$ inches | $Q_1$ inches | $Q_2$ inches | $Q_3$ inches | $Q_4$ inches | inches | inches | inches | inches |
| Sept. 7, 1938 | 55 | .98 | 1.04 | 1.06 | .96 | .15 | .09 | .10 | .13 | .83 | .95 | .96 | .83 |
| Sept. 8 | 28 | .70 | .77 | .74 | .70 | .09 | .06 | .07 | .09 | .61 | .71 | .67 | .61 |
| Sept. 13 | 42 | .71 | .80 | .73 | .70 | .21 | .10 | .16 | .17 | .50 | .70 | .57 | .53 |
| July 26, 1940 | 35 | 2.96 | 2.90 | 2.85 | 2.99 | .83 | .43 | .52 | .96 | 2.13 | 2.47 | 2.33 | 2.03 |
| Aug. 3 | 37 | 2.30 | 2.38 | 2.30 | 2.34 | .41 | .32 | .26 | .50 | 1.89 | 2.06 | 2.04 | 1.84 |
| May 28, 1941 | 96 | 1.81 | 1.75 | 1.83 | 1.76 | .16 | .04 | .07 | .13 | 1.65 | 1.71 | 1.76 | 1.63 |
| Sept. 18, 1942 | 35 | 1.37 | 1.38 | 1.39 | 1.38 | .09 | .07 | .03 | .07 | 1.28 | 1.31 | 1.36 | 1.31 |
| Sept. 18 | 10 | .45 | .51 | .49 | .43 | .06 | .08 | .04 | .04 | .39 | .43 | .45 | .39 |
| June 2, 1943 | 88 | 1.14 | 1.09 | 1.14 | 1.12 | .24 | .05 | .12 | .20 | .90 | 1.04 | 1.02 | .92 |
| June 3 | 13 | 1.06 | 1.05 | 1.04 | 1.07 | .26 | .13 | .17 | .31 | .80 | .92 | .87 | .76 |
| Aug. 12 | 23 | 2.12 | 2.10 | 2.25 | 1.97 | .46 | .14 | .38 | .43 | 1.66 | 1.96 | 1.87 | 1.54 |
| Aug. 13 | 42 | .91 | 1.01 | .85 | .92 | .18 | .03 | .10 | .18 | .73 | .98 | .75 | .74 |
| June 17, 1944 | 33 | 1.03 | 1.11 | 1.16 | 1.02 | .33 | .46 | .35 | .30 | .70 | .65 | .81 | .72 |
| June 22 | 32 | 1.45 | 1.55 | 1.51 | 1.50 | .35 | .54 | .30 | .33 | 1.10 | 1.01 | 1.21 | 1.17 |
| July 11 | 27 | 1.95 | 2.00 | 1.99 | 1.94 | .26 | .46 | .15 | .20 | 1.69 | 1.54 | 1.84 | 1.74 |
| June 1, 1945 | 61 | 1.28 | 1.34 | 1.26 | 1.33 | .35 | .41 | .18 | .36 | .93 | .93 | 1.08 | .97 |
| June 28 | 19 | 1.01 | 1.01 | 1.03 | .97 | .49 | .62 | .39 | .47 | .52 | .39 | .64 | .50 |
| June 24, 1949 | 24 | 1.37 | 1.28 | 1.32 | 1.40 | .42 | .23 | .21 | .46 | .95 | 1.05 | 1.11 | .94 |
| July 15, 1950 | | | | | | | | | | | | | |
| 7:07- 7:45 p.m. | 34 | 1.88 | 1.85 | 1.79 | 1.88 | .29 | .13 | .18 | .31 | 1.59 | 1.72 | 1.61 | 1.57 |
| 9:30-10:15 p.m. | 45 | 1.50 | 1.68 | 1.61 | 1.51 | .75 | .75 | .68 | .78 | .75 | .93 | .93 | .73 |
| 10:15-11:15 p.m. | 74 | 1.67 | 1.68 | 1.71 | 1.71 | .63 | .48 | .56 | .71 | 1.04 | 1.20 | 1.15 | 1.00 |
| 11:55-end | | 2.14 | 2.09 | 2.20 | 2.10 | 1.02 | .90 | .96 | 1.06 | 1.12 | 1.19 | 1.24 | 1.04 |
| Storm total | 360 | 7.30 | 7.41 | 7.42 | 7.31 | 2.69 | 2.26 | 2.38 | 2.86 | 4.61 | 5.15 | 5.04 | 4.45 |
| July 19, 1950 | 15 | .59 | .64 | .61 | .59 | .15 | .07 | .16 | .13 | .44 | .57 | .45 | .46 |
| Aug. 5-6, 1951 | 180 | 5.98 | 5.90 | 6.03 | 5.80 | 1.85 | 1.78 | 1.44 | 1.72 | 4.13 | 4.12 | 4.59 | 4.08 |
| June 21, 1954 | | | | | | | | | | | | | |
| 2:23-3:05 p.m. | 42 | 1.57 | 1.75 | 1.65 | 1.48 | .48 | .31 | .43 | .45 | 1.09 | 1.44 | 1.22 | 1.03 |
| 3:52-4:51 p.m. | 59 | 1.18 | 1.23 | 1.19 | 1.18 | .36 | .16 | .30 | .37 | .82 | 1.07 | .89 | .81 |
| 6:45-6:55 p.m. | 10 | .52 | .63 | .51 | .49 | .16 | .07 | .12 | .16 | .36 | .56 | .39 | .33 |
| Storm total | 272 | 3.35 | 3.67 | 3.43 | 3.24 | 1.00 | .54 | .85 | .97 | 2.35 | 3.13 | 2.58 | 2.27 |

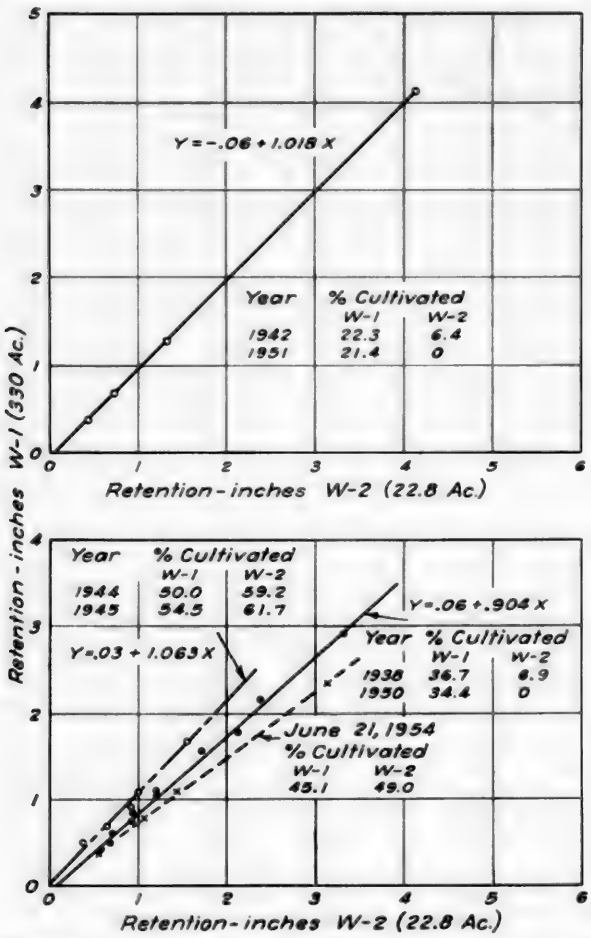

Y = -.06 + 1.018 X
Year | % Cultivated W-1 | W-2
1942 | 22.3 | 6.4
1951 | 21.4 | 0
Retention - inches W-1 (330 Ac.)
Retention - inches W-2 (22.8 Ac.)
Year | % Cultivated W-1 | W-2
1944 | 50.0 | 59.2
1945 | 54.5 | 61.7
Y = .03 + 1.063 X
Y = .06 + .904 X
Year | % Cultivated W-1 | W-2
1938 | 36.7 | 8.9
1950 | 34.4 | 0
June 21, 1954 % Cultivated W-1 | W-2
45.1 | 49.0
Retention - inches W-2 (22.8 Ac.)

**Figure 2. Retention for selected storms on experimental watersheds 1 and 2, Fennimore, Wisconsin.**

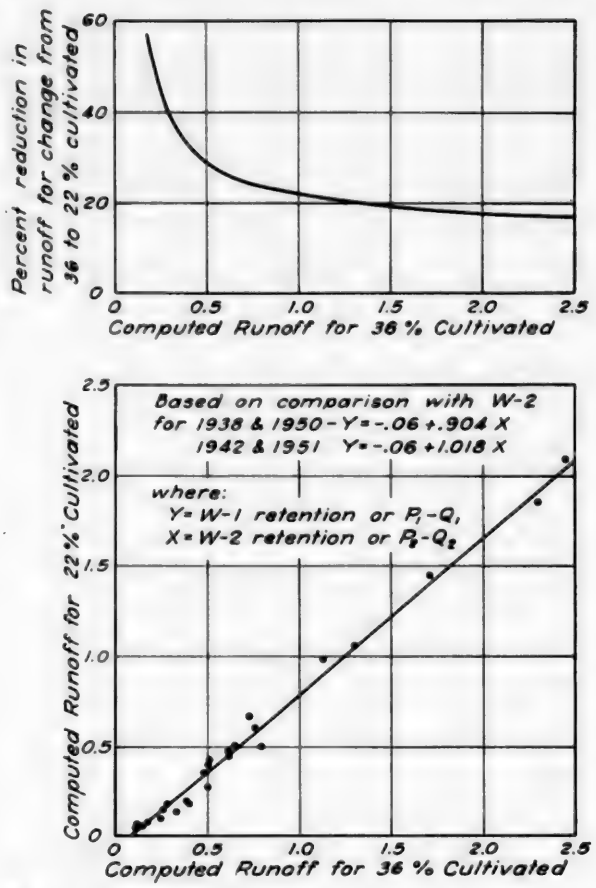

Percent reduction in runoff for change from 36 to 22 % cultivated
Computed Runoff for 36 % Cultivated
Based on comparison with W-2
for 1938 & 1950 - Y = -.06 + .904 X
1942 & 1951 Y = -.06 + 1.018 X
where:
Y = W-1 retention or P1 - Q1
X = W-2 retention or P2 - Q2
Computed Runoff for 22 % Cultivated
Computed Runoff for 36 % Cultivated

**Figure 3. Computed single storm runoff on experimental watershed 1 at Fennimore, Wisconsin.**

to 20 inches. These soils are included in the Soil Conservation Service's classification system under hydrologic group C. The areas are rather flat in the upper portions but drop off rather abruptly (maximum slopes of 30 percent) near the waterways. Each of the watersheds is dissected with a system of well-defined waterways. The 290-acre watershed has four small ponds having a total drainage area of about 30 acres or 10 percent of the watershed area. Records have been kept of the precipitation, runoff, temperature, humidity, and cover conditions on these watersheds from March 1938 through 1955. Continuous records of runoff were obtained with water level recorders located above precalibrated weirs.

**TABLE 4**
**Characteristics of the Experimental Watersheds Edwardsville, Illinois.**

| Watershed Number | W-1 | W-2 | W-4 |
|---|---|---|---|
| Drainage Area-*acres* | 27.2 | 50 | 290 |
| Range in Elevation-*feet* | 520-540 | 497-536 | 479-542 |
| Prevailing Land Slopes *percent* | 1 | 1 and 4 | 1 and 4 |
| Average Waterway Slope *percent* | 1.8 | 1.8 | 1.1 |
| Soils: *percent of area* | | | |
| Bogota silt loam | 81 | 60 | 52 |
| Alma silt loam | 18 | 13 | 14 |
| Haymond fine sandy loam | 1 | 5 | 6 |
| Elcho silt loam | | 22 | 22 |
| Whitson silt loam | | | 6 |
| Land Capability: *percent of area* | | | |
| Class II | 84 | 49 | 57 |
| Class III | 16 | 35 | 22 |
| Class IV | | 11 | 18 |
| Class VI | | 5 | 3 |
| Recording Rain Gauges *number* | 1 | 2 | 7 |

The data obtained from the Edwardsville watersheds are applicable to large areas of southern Illinois, Missouri, eastern Kansas, and northern Oklahoma.

## Cover Conditions on Edwardsville Watersheds

The entire 27.2-acre area at Edwardsville, Illinois, was in alfalfa continuously from 1940 through 1944. It was 96 percent cultivated in 1938, 1948, 1949 and 1951, and over 60 percent cultivated during all other years of record. Cover on the 290-acre area varied from 20 to 30 percent cultivated with the rest in permanent pasture (and an unpastured woodlot) for the entire period of record.

### Effect of Cover on Runoff from Claypan Soils

Figure 4 is a double-mass plotting of the May-October accumulated runoff for watersheds, W-1 (27.2 acres) and W-4 (290 acres) at Edwardsville. Runoff for the period 1945-1954 was about 15 percent higher on W-1 (two-thirds cultivated) than on W-4. However, when W-1 was in 100 percent alfalfa (1940-1944), the runoff from this area was 16 percent less than from W-4. Thus, there is only a 30 percent reduction in total May-October runoff on the Edwardsville, Illinois, claypan soils for a change from nearly 100 percent cultivated to 100 percent alfalfa.

### Comparison of Cover Effect on Surface Runoff

The summer runoff-producing potentials of the two soil types represented by the Fennimore and Edwardsville watersheds are quite different. The total May through October runoff on the moderately permeable soils of watershed 4 (171 acres, mixed cover) at Fennimore, Wisconsin, for 21 summers (1939-1959) was 13.89 inches or an average of 0.70 inches per year. In contrast to this, the total May through October runoff on the claypan soils of watershed 4 (290 acres) at Edwardsville, Illinois, for 18 years was 61 inches or an average of 3.4 inches per year, nearly five times the Fennimore average. This difference in runoff between the two areas must be attributed to soil type since the average May through October rainfall during the period of record at Edwardsville was 21.4 inches as compared with 22.2 inches at Fennimore and the Fennimore watershed had about twice the percentage under cultivation as did the Edwardsville watershed. Only 3.2 percent of the May through October rainfall on the Fennimore watershed appeared as surface runoff as contrasted with 16 percent on the Edwardsville area.

Computations were made to determine the effect of changes in cover on single storm runoff from the watersheds at Fennimore, and the 27.2-acre watershed at Edwardsville. The results, given in table 5, show that on the claypan soils at Edwardsville, with a change in cover from nearly 100 percent cultivated to 100 percent alfalfa, the reduction in storm runoff will not exceed 10 percent for floods recurring on the average not oftener than every 2 years. Table 5 shows that considerably smaller changes in percent of cultivated area on the permeable soils at Fennimore result in somewhat greater changes in the storm runoff.

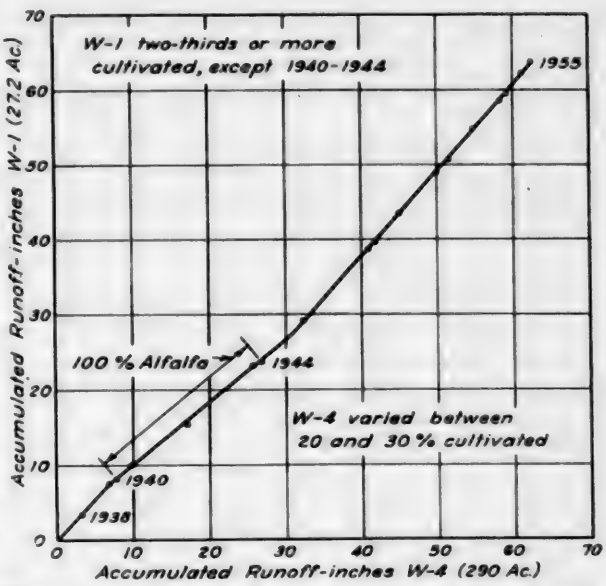



**Figure 4. Comparison of accumulated total May through October runoff, 1938-1955, from experimental watersheds 1 and 4, Edwardsville, Illinois.**

Table 5 also shows the estimated single storm runoff for different frequencies on one Fennimore and one Edwardsville watershed. These values were determined by using a partial duration series which included all storms having more than 0.20 inches of runoff.

Table 6 shows comparisons of selected storms on the Fennimore and Edwardsville watersheds. In these comparisons an attempt was made to pair storms having similar rainfall patterns and to pair the antecedent soil moisture conditions so that the differences in runoff would reflect either a difference in soil type or crop cover. The first two pairs show vividly the effect of change in cover on rates and amounts of runoff from the small watershed at Fennimore. The group of three storms at Edwardsville illustrate the fact that these claypan soils can retain relatively large amounts of rainfall when the soil moisture

**TABLE 5**

**Estimated Storm Runoff for Various Intervals and the Percent Reduction in Runoff for Selected Reductions in Percent of Area Cultivated, Fennimore, Wisconsin, and Edwardsville, Illinois, Experimental Watersheds.**

| | *Estimated Single Storm Runoff* | | *Percent Reduction in Runoff Resulting from Reduction in Cultivated Area* | | | |
|---|---|---|---|---|---|---|
| Location | Fennimore | Edwardsville | Fennimore, Wisconsin | | | Edwardsville Illinois |
| Watershed Number | W-4 | W-4 | W-1 | W-2 | W-4 | W-1 |
| Drainage Area-*acres* | 171 | 290 | 330 | 22.8 | 171 | 27.2 |
| Percent Cultivated | 50 | 20-30 | 36 → 22 | 60 → 0 | 45 → 28 | 96 → 0 |
| Recurrence Interval *years* | *inches* | *inches* | *percent* | *percent* | *percent* | *percent* |
| 2 | 0.40 | 1.40 | 30 | 57 | 37 | 10 |
| 5 | 0.90 | 2.10 | 19 | 40 | 24 | 8 |
| 10 | 1.50 | 2.75 | 18 | 33 | 21 | 8 |
| 25 | 2.40 | 3.50 | 17 | 30 | 19 | 7 |
| 50 | 3.00 | 4.00 | 16 | 29 | 18 | 6 |

TABLE 6

**Comparison of Runoff and Retention Produced by Selected Storms on the Silt Loam Soils at Fennimore, Wisconsin and the Claypan Soils at Edwardsville, Illinois.**

| Watershed | Date | Area Cultivated | Precipitation | | Runoff | | | Retention | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Amount | Duration | Amount | Precipitation | Peak Rate | Amount | Precipitation |
| | | percent | inches | minutes | inches | percent | inches/hour | inches | percent |
| W-2 Fennimore | July 11, 1944 | 59 | 1.92 | 27 | .46 | 24.0 | 2.69 | 1.46 | 76.0 |
| | July 15, 1950 | 0 | 1.80 | 34 | .13 | 7.2 | .34 | 1.67 | 92.8 |
| W-2 Fennimore | June 28, 1945 | 61 | 1.90 | 75 | .62 | 32.6 | 2.68 | 1.28 | 67.4 |
| | June 28, 1947 | 0 | 2.40 | 90 | .20 | 8.3 | .60 | 2.20 | 91.7 |
| W-1 Edwardsville | Sept. 2, 1941 | 0 | 1.61 | 60 | .25 | 15.5 | .47 | 1.36 | 84.5 |
| | Aug. 2, 1949 | 60 | 1.86 | 70 | .78 | 42.0 | 1.00 | 1.08 | 58.0 |
| | Sept. 12, 1951 | 78 | .90 | 35 | .12 | 13.3 | .11 | .78 | 86.7 |
| W-2 Fennimore | July 19, 1950 | 0 | .70 | 24 | .07 | 10.0 | .12 | .63 | 90.0 |
| W-1 Edwardsville | July 9, 1942 | 0 | .81 | 90 | .60 | 74.0 | .60 | .21 | 26.0 |
| W-1 Edwardsville | Aug. 15, 1946 | 50 | 1.45 | 50 | 1.18 | 81.4 | 1.32 | .27 | 18.6 |
| W-2 Fennimore | Aug. 3, 1940 | 27 | 2.35 | 51 | .32 | 13.6 | 1.03 | 2.03 | 86.4 |
| W-1 Edwardsville | July 8, 1942 | 0 | 2.35 | 80 | 1.60 | 68.1 | 1.41 | .75 | 31.9 |

is low at the beginning of the storm period and that cover does not exert the large influence it does at Fennimore. Prior to the storms of July 19, 1950, July 9, 1942, and August 15, 1946, soil moisture was at a high level and the lower retention of the claypan soils at Edwardsville is very apparent. The last pair of storms were selected because of low antecedent soil moisture conditions and they also show higher retention by the soils at Fennimore.

## Summary

A change in percent of area cultivated has considerable influence on storm runoff from moderately permeable silt loams but only minor effect on claypan soils. On the claypan soils, a cover change from nearly 100 percent cultivated to 100 percent alfalfa will result in a reduction in storm runoff not exceeding 10 percent. On the moderately permeable silt loams, represented by the Fennimore watersheds, a reduction in storm runoff of more than 50 percent may result if cover is changed from 60 to 0 percent cultivated.

From approximately the same average May through October precipitation of 22 inches, the surface runoff from the claypan soils at Edwardsville averaged 3.4 inches per year, or nearly five times as much as for moderately permeable silt loams at Fennimore.

The June 21, 1954, storm on watershed W-2, Fennimore, showed that a good sod mulch is very effective in reducing erosion and surface runoff.

When dry and protected by a good vegetative cover, even the claypan soils will take in precipitation rather rapidly until the surface layer becomes saturated, after that a high percentage of any additional precipitation will run off.

The effects of cover on runoff are quite pronounced for small storms but of only minor importance in storms causing major floods.

Further research is necessary to determine the effect of cover changes on runoff from other soil types and also the limit in size of watershed to which the results would be applicable.

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***"The 'growing up' of resource conservation directly concerns every one of us. It challenges the capacities of all of us for meeting the multiplied demands on our knowledge and energies, and for maximum coordination of our efforts for the most efficient production from our manpower and other facilities. The resource conservation job is too big for any one agency or group, governmental or private, to do alone. It is more essential than ever that everybody work together at the job of proper use of the land and water that enables the soil to produce the food and fiber, grass, timber and wildlife we need, in the amounts needed when we need them."***

—**George R. Phillips**, *Director*
*River Basins Division*
*Soil Conservation Service*

# Soil Conservation in a Changing World

JOHN F. TIMMONS

***The first part of this article appeared in the September-October, 1961 issue of the Journal. Changes in population and resource productivity were assessed by the author. In this final part of his treatise these fundamental changes are interpreted as providing important guidelines for redirecting the conservation movement during the next few decades.***

SOIL CONSERVATION has been referred to as one of the most dramatic and significant social movements of the twentieth century (*2*). I agree with this statement. But no movement can coast into continued significance. The future of the soil conservation movement depends in great measure on how well its leaders and workers visualize and appreciate the changes going on about us and how well they succeed in keeping conservation geared to current and prospective change.

Over two millenniums ago, the great Greek philosopher, Heraclitus wrote, "There is nothing permanent except change." This article is concerned with the meaning of change to soil conservation and some of the implications involved in keeping the soil conservation movement in tune with and abreast of changes in process and in prospect.

Fundamental changes are under way in our national and international societies which necessitate basic changes in both our philosophy and our applications of soil conservation (*6*). We are experiencing population and technological revolutions of explosive character. We are heavily committed to international responsibilities which impel us to share our technical knowledge and the fruits of our soil resources with less developed nations. At the same time we must keep our soil resources productive as the continuing foundation of our national security and economic growth.

The soil conservation slogans of the past, "getting the job done," "hold soil losses to fixed tons per acre," "save the soil for posterity" and "only 6 inches of topsoil between the human race and starvation," which helped launch the soil conservation movement, must give way to new concepts and new thought geared to our changing world.

The fundamental changes in population and in technology provide important guidelines for redirecting the conservation movement through the remaining decades of the twentieth century. These changes bring challenging opportunities as well as serious responsibilities for all of us engaged in the many aspects of soil conservation. Our major task remains that of unlocking nature's secrets of soil productivity through basic research and translating these findings into increased soil productivity through continuing education, technical assistance, capital investment, applied research and related measures. However, new and modified concepts of soil conservation are needed to keep the soil conservation movement abreast of changing conditions. For further consideration, nine new or modified concepts are suggested here:

1 We need a new concept of soil conservation which embodies four elements (*5*). *One element* consists of moving land use to a higher production function over time or preventing land use from falling to a lower production function. A *second element* consists of differentiating between production practices and conservation practices. Production practices move land use back and forth on the same production function within a reversible range of productivity. Conservation practices involve present investments which move land use to a higher level of productivity or prevent productivity from declining to an irreversible level on a lower production function.

A *third element* includes consideration of all uses of particular soil resources and all relevant resources which may complement or substitute for particular soil resources in producing the goods and services people want. A *fourth element* consists of lowering the unit output cost of goods and services produced from soil resources in order that both producers and consumers benefit from soil conservation.

Although these four elements are highly interrelated and interdependent, special consideration should be given the fourth element in light of current surplus agricultural production. Lowering the unit output cost of goods and services from land resources can always be justified from producer and consumer or private and public viewpoints. The development of our knowledge of resource use and its application to land resources has enabled us to provide an abundance of food and fiber.

Our soil productivity must be regarded as one of our major national assets, not as a burden seen only as surplus food and fiber. Our agricultural production potential is the envy of Russia and China and they strain to

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emulate it. The problem centers around adjusting our agricultural production to meet changing demands consistent with national economic growth. The solution must not be permitted to interfere with the advance and application of knowledge that generates our resource productivity for this new technology is a major bulwark of the national security and economic growth.

**2** *Soil resources must be regarded as expansible through new knowledge and applied technology.* This means that soil resources can no longer be regarded as fixed in terms of acres of land or inches of topsoil. On the contrary, soil resources must be regarded in terms of their productivity made possible by new knowledge. The productivity of our soil resources is limited only by the development of knowledge which is infinite. Of course, the translation of knowledge into increased soil productivity is blocked by numerous economic, institutional, social, and political obstacles. An important part of the soil conservationist's job of the future is the removal or alleviation of these obstacles in the application of soil conservation measures.

**3** *An increasingly larger share of our soil conservation personnel and knowledge must be devoted to the less developed countries.* In light of vastly accelerated population growth in process and in prospect in the less developed countries, more attention must be given to how these countries may make their soil resources more productive. This involves extending our fields of inquiry to the soil resources of these countries and to the social, economic and institutional factors blocking increased soil productivity. In meeting our international commitments, trained conservation technicians are in exeeedingly short supply.

The world has become our campus, and our research and training programs must measure up to this extended responsibility. Fortunately, the United States possesses a sizable cadre of soil conservation technicians but it is not adequate in light of our increasing commitments to less developed countries.

**4** *Major uses of land are moving toward core areas which enjoy comparative and absolute advantages of specialization in the extended application of technology.* It is becoming obvious that technology is rapidly moving concentrated production of corn, wheat, cotton and other crops into relatively small core areas that are most responsive to the application of technology. This means that increasingly larger areas of land falling between the core areas of production will be shifting away from crops. Land technologically released from crop production may become an appreciable segment of our land base in the future.

This development has significant implications for soil conservation since conservation measures needed for cropland may become obsolete when the land shifts from crops. This means that core areas of future concentrated crop production must be identified and distinguished from areas being released from crop production. Conservation measures should be concentrated within the core areas of production. Conservation practices in the relinquished areas must be geared to soil resource storage measures which will keep the unneeded soil areas inherently productive within reversible limits and as a productivity reservoir ready for future contingencies. Of course, some of these lands will shift to more intensive uses demanded by our growing urban population. Other lands will shift to recreational, grazing, and forest uses.

**5** *Water conservation is becoming an increasingly important segment of the soil conservation complex.* The demand for water during the coming years and decades will force an increased emphasis on water conservation. The nature of water conservation measures will extend from providing and protecting water for urban, industrial, navigational, and recreational uses, to measures for storing water in the soil and on the land for agricultural purposes. Since a large proportion of water in the humid and semihumid sections of the nation now runs off or evaporates, water conservation measures are extremely important. Growing nonfarm demands for water, accompanied by higher water requirements for crops grown under new chemical and biological technologies, dictate that increased attention be given to water conservation in the conservation movement of the future.

**6** *Contingency reserves of soil productivity must be maintained for insuring national security and economic growth.* In light of the uncertainties which the future may hold in terms of international demands in peace or in war, wisdom would seem to require providing sizable contingency reservoirs of soil productivity. Such reservoirs of soil productivity beyond current or prospective needs should be kept within reversible use limits.

**7** *Units of agricultural production must be planned for economic as well as physical objectives.* Of special concern to soil conservation districts is the need for extending educational and technical assistance to include increased emphasis on economic considerations in developing soil conservation plans. The use of minimum soil losses in terms of tons per acre is no longer adequate as a major objective in farm planning.

Many district cooperators and noncooperators alike remain unconvinced of the profitableness to them of particular conservation practices and combinations of practices suggested in their farm plans. Designed largely for erosion control, many farm plans, in the opinion of farmers, remain incomplete until the plans are further developed to reveal expected costs, income, capital requirements, and the like (*1, 3, 4*). In the future, co-

operators and potential cooperators of districts must be provided with economic analyses of farm plans in terms of alternative systems of practices, farmers' preferences, and restrictions implicit in the farmers' situation. They may then visualize more clearly the income impacts and benefits of conservation measures. With the advent of electronic computers, this forward step in farm planning is well within the range of possibility and desirability.

**8** *Public support for soil conservation must be based on fact and less reliance placed on emotional appeal.* Public funds available for support of soil conservation are limited and must be weighed against military, health, education, welfare, international aid and other public requirements. It is becoming essential that aims and plans for future soil conservation needs for public funds be supported by facts and analyses of the total resource use picture. Otherwise, the nation may fail to provide adequately for the conservation of soil resources as the continuing foundation of national security and economic growth.

**9** *Soil conservation is a continuing process; it does not terminate when a particular job is finished.* Many district cooperators either drop out of the program or fall behind in carrying out their farm plans. Insufficient time has been devoted to servicing and follow-up work on farm plans after the plans have been developed. This is due in part to insufficient educational and technical assistance available in the soil conservation district. Farm plans tend to be fixed; yet, the forces such as weather, insects and diseases, technological developments, cost and price changes, changes in farm ownership, and changes in operators of farms, which affect the carrying out of the plans are exceedingly dynamic. In order to keep farm cooperators and cooperating farms in the program and on schedule in progress on farm plans, increased time and effort must be devoted to keeping farm plans adjusted to the dynamic agricultural environment within which plans must be carried out.

This may be accomplished through expanded educational programs emphasizing basic principles, interrelationships, changing conditions, and alternative approaches which the cooperator himself may design in order to carry out adjustments necessary to meet changing conditions; expanded technical assistance to farmers in revising plans and in implementing adjustments in individual farm plans occasioned by external changes is also needed.

These then are the suggested fundamental changes in the nature and content of soil conservation. Whether or not the soil conservation movement continues to merit acclaim as one of the important social movements of the twentieth century depends on how well it accommodates and provides for change. This is our challenge.

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# Drainage in the Imperial Valley of California

JEROME J. MOLOF

DRAINAGE is one of the most important factors in maintaining high productivity on farmlands in southern California's Imperial Valley. Land leveling, crop rotations, fertilizer applications and irrigation water management are needed, but it is not possible to continue profitable farming in the Valley unless the excess saline waters are removed.

The practical answer to this drainage problem appears to be the installation of tile drains. Though the practice of tile drainage is well known, the conditions which make it absolutely necessary for permanently successful crop production in the Imperial Valley are not so well understood.

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Before Imperial Valley became a modern "Garden of Eden," the mighty Colorado River poured its waters and sediments into it for thousands of years; many deep layers of silt, sand, clay, and gravel were laid down. Oil seekers in the Valley have recently drilled as deep as 12,000 feet before hitting bedrock. Compared to other areas, the Valley has a "gold mine" of soil and soil material. With an average slope of only 0.10 percent, soil erosion is not a big problem.

At the beginning of the twentieth century the Imperial Valley was a dry, barren desert. Valley soils consisted of the raw, stratified depositions laid down by the river centuries ago. Underground dikes of clay, saucer-shaped strata, lens-like layers of sand and clay, and layers of sand pinched off into clays were the soil materials which

offered themselves to the plow. These irregular, river-laid deposits did not, of course, have adequate natural drainage.

Salts were distributed uniformly throughout the sediments at the time they were deposited. Irrigation of these soils not only redistributed the salts in the various soil layers, but they were also moved closer to the surface as the result of improper water management.

### Salt Accumulation in the Soil

Normal weathering breaks down the minerals in the earth's crust and this action releases soluble salts. In most areas of the country there is enough rainfall to carry excess salts through the soil and into the ground water. However, in arid regions such as the Imperial Valley, there is not enough rainfall to leach the salts out of the soil. Low rainfall (2 inches annually in the Imperial Valley), high evaporation rates, and water use by plants favor salt accumulation, but these conditions alone usually do not cause excessive soil salinity.

Harmful amounts of salt come largely from the substrata zone, which is from 5 to 25 feet below the surface. The ground water in this zone is highly saline and contains up to 75 tons of salt per acre foot of water. Unless this saline water is removed by the tile drainage system, capillary action and evaporation processes cause the salt to rise to the topsoil area. A certain amount of salt is also brought into the Valley by the All-American Canal system which delivers water from the Colorado River. This water normally contains a ton of salt per acre foot.

From 1903 to 1945 thousands of acres of fertile land in the Valley went out of production because the methods of removing salt from the soil were inadequate. However, the tide has turned; not only is land no longer being removed from production by salt build up, but the soils where salts have accumulated are being reclaimed. Construction of open and tile drains, leveling land to designed grades, and improved management of both soil and water are responsible for the fact that today Imperial County ranks seventh in agricultural income among all counties in the United States. The story of the program to prevent further salt accumulation and to reclaim land already forced out of production is as remarkable as that of the original transformation of the Valley from barren desert to one-half million irrigated productive acres.

### Drainage for Salt Removal

A tile drainage system in an arid irrigated area has three functions to perform: (a) Remove saline water during leaching operations, (b) maintain ground water at safe levels during normal irrigation, and (c) keep saline water in the area below the drainage system from returning to the soil surface.

Leaching, a process in which extra water added to a field is allowed to soak through the soil and remove the salt, is normally done between crops when fields are idle. A common method of leaching is to pond water on the surface over the entire field, but this practice will not effectively remove salts if the ground water table is too close to the surface. Therefore, adequate tile drainage systems to lower the free ground water table are necessary so that the saline water can move out of the soil profile. On the finer-textured soils, leaching for 120 days in conjunction with tile drainage has proved to be the most economical method of soil reclamation. Coarse-textured soils may be reclaimed by leaching for 60 days or less, and tile drainage may not be necessary.

Tile were first installed in the Valley in 1929, but it was not until 1949 that progress in salt removal was noted. At that time an investigation showed that more salt was being removed from the Valley than was being brought in by the water from the Colorado River.

Using the channels of the two rivers in the Valley as main trunk outlets, construction was begun in 1922 on a system of parallel open drains approximately one-half mile apart. Today the Imperial Irrigation District operates and maintains about 1,600 miles of open drains.

It is district policy to provide a tile outlet for each quarter-section of land in the Valley. Where open outlets are not adequate, the district will construct and maintain, at district expense, a sump pump outlet. All tile are installed by the landowner.

### Planning Tile Drain Programs

Investigations pertaining to a need for tile are carried out by Soil Conservation Service personnel and Imperial Irrigation District drainage engineers. Though some problems are fairly simple and solutions are quickly apparent, there are no short-cut methods of investigation uniformly applicable to the analysis and solution of all drainage problems. Generally, the soil, water, cropping, and irrigation practices are so varied on even small areas that a complete and thorough evaluation is needed to determine the specific causes of undesirable drainage conditions and to serve as a basis for recommending corrective action.

A typical soil survey involves making borings spaced 660 feet apart on a grid pattern. On a 40-acre field, six to nine such borings 7 to 9 feet deep are made and the data secured are recorded on a soil profile chart. When definite drainage barriers are being sought the soil surveyor must drill to depths of 15 feet.

The sequence of tight clay and open sand layers in the soil profile and the ability of these separate layers to transmit water, largely determine tile spacing. The soil survey, which gives the location, extent, and physi-

cal characteristics of the various underlying soil layers, is probably the most important single technical phase of the drainage investigation.

In addition to the soil and water table data needed, surface slopes of the land must be determined. This information is obtained either from topographic maps or by running three or four lines of levels across a field. Tile outlet location and depth are also determined during the topographic survey.

The soil surface levels are plotted on cross section paper. Soil survey well logs plotted upon these profiles present a clear picture of the extent of the strata encountered. With the aid of these data, it is possible for the engineer to plan a tile system that will tap all of the lens, saucers and blind strata. A determination of soil permeability indicates the allowable distance between tile laterals. The following spacings are used:

| *Permeability* (*inches per hour*) | *Lateral Spacing* (*feet*) |
|---|---|
| .05 to .1 | 75 to 125 |
| .1 to 1.0 | 125 to 200 |
| 1.0 to 2.5 | 200 to 250 |
| 2.5 to 4.0 | 250 to 300 |
| 4.0 to 5.0 | 300 to 400 |

The most common tile system consists of a main collecting line or base line into which parallel lateral lines flow. A tile system designed to drain 160 acres will generally utilize a combination of 8 inch and 6 inch tile for the base line, and laterals will be 4 inches in diameter.

Machines have been developed which can dig the trench, lay the tile in a blanket of gravel filter material and partially backfill the trench in one operation. This method insures even grades and safety of operation. Nearly all tile are installed 6 to 9 feet deep, and in some cases installations are 11 feet under the surface. Because of the stratified soil conditions and fine soil textures, a sand-gravel filter is placed around all drain tile.

### Drainage Pays

The amount of private tile drainage in the Valley is remarkable. From 1929 through 1960 a total of 7,800 miles was laid. Half of the acreage in the Valley is now tiled and there is reason to believe that the majority of farms in the Valley will eventually be tiled for there are very few areas where drainage is adequate.

Five contractors are now operating 11 large trenching machines on a full-time basis.

Cost of tile installation varies from $60 to $200 per acre depending on size of tile and spacing of laterals. The cost to farmers, including labor and materials, is $0.40 a foot for 4 inch, $0.50 a foot for 6 inch, and $0.60 a foot for 8 inch tile. For installations over 8 feet in depth an additional $0.20 per foot of depth is charged. Farmers select the type of tile installed, but throughout the Valley either 1-foot sections of clay tile or 2-foot sections of concrete tile are used.

Imperial Irrigation District Photo

**Water is being ponded for leaching on a ranch in the Imperial Valley. Soluble salts are removed from the plant root zone by allowing the water to soak through the soil. The saline water is then moved from the land through underground drainage systems.**

A new type of tile pipe has recently been developed in the Valley. Long sections of perforated fibre pipe covered with a one-half inch thickness of fibre glass material are now being installed. The pipe is held together with coupled joints and water enters it only through the perforations. It is installed with the two rows of parallel perforations placed upward so the fibre glass material can be placed over the top 60 percent of the pipe. No gravel filler material is being used. A new tile trencher has been designed to install this bituminous pipe and the fibre glass cover in one operation.

Many drainage systems pay for themselves during the first year or two of use. On land previously abandoned because of salt accumulation, lush fields now meet the eye. Alfalfa fields that once yielded 3 tons per acre yield 10 tons after tiling. Where cotton formerly produced less than a bale to the acre, the yield is now 2.5 bales and many farmers are getting 3 to 4 bales from each reclaimed acre. Where barley yields were 2,200 pounds they are now 6,000 pounds per acre. Land that did well to produce 24 bushels per acre of wheat before tiling now yields 66 bushels per acre. Where poor, spotty fields of sugar beets were seen one now finds beets yielding 25 tons an acre. In this age of more and more efficiency in agricultural operations, the Imperial Valley farmer realizes that drainage is a necessity. He has proven, conclusively, that drainage pays.

Predictions have been made that irrigated valleys, subject to the kind of salt accumulation that has been occurring in the Imperial Valley, would be short-lived, so far as agricultural production was concerned. It is true that successful crop production becomes increasingly difficult if injurious salts accumulate in the plant root zone. Unless special measures are taken, crop growth becomes impossible. In the Imperial Valley, permanently successful crop production absolutely depends on the maintenance of effective drainage.

# Present Day Irrigation in Hawaii

RONALD I. BLEWITT

***Since ancient times, when Hawaiians constructed an irrigation ditch or "auwai" to bring water from a stream to their taro[1] patches, irrigation has been a part of rural Oahu. Today, more than 131,000 acres are irrigated. Most of this land is watered by surface methods, but on several thousand acres, large and complicated machines are used for sprinkler irrigation.***

ALL LANDS IN HAWAII belonged to the succession of chiefs and kings until the Great Mahele (land division agreement) in 1848. The division of lands made by the privy council at that time gave approximately one-third of the land to the kings and chiefs, one-third to the government, and one-third to the common people. The right to water for irrigation of taro patches was attached to the land.

The Great Mahele was the first step in paving the way for development of large sugar cane and pineapple plantations. Until 1850, foreigners could not own land in fee simple, but when that right was granted new irrigation development began.

### Irrigation Methods Vary

Irrigated crop lands in Hawaii have a wide range of physical features. Some soils are nearly all sand or rock while others are over 75 percent clay. Field intake rates under furrow irrigation range from less than three-fourths of an inch to 6 inches per hour. Topography varies tremendously; in some places the land is nearly level while in others 45 percent slopes are common. Annual rainfall varies from less than 10 inches in some areas to more than 80 inches in other regions. In some areas there is very little wind—average velocities of one-half mile per hour are recorded. However, in some valley and plateau areas wind velocities average 14 miles per hour for the year.

Many different crops are grown and irrigated. These include papaya, lychee, pineapple, lotus root, rice, taro water crops and most of the fruits and vegetables usually grown in the temperate zones. Water requirements of the drought resistant pineapple are low, but watercress requires a continuous water supply. Water costs range from $3 to $98 per acre-foot. Thus, it is only natural that water application methods, equipment, and irrigation practices should vary widely in Hawaii.

Surface irrigation is the most common method of supplying water to sugar cane, vegetable row crops, and the water crops. Sprinkler irrigation is used on pineapple, pasture, and many fruits and vegetables. Furrow and basin systems are used for surface irrigation. Ingenious concrete flumes, concrete pipelines, and metal flumes have been developed to deliver water to furrows. However, some small taro patches are still irrigated with the same ditches as they were when Captain Cook described them in 1778 (figure 1).

### Surface Irrigation of Sugar Cane

Sugar cane is the major agricultural crop in Hawaii, and of the 222,000 acres in sugar cane, 120,000 are irrigated. Soon after this crop was first grown in Hawaii it became apparent that water in excess of rainfall would be beneficial. To meet this need, irrigation ditches were constructed; the first one was completed in 1856 on Kauai. It was 11 miles long and delivered water to the Lihue Plantation Company.

The first system of water distribution in cane fields was the contour system. It consisted of level ditches, watercourses, and contour furrows. The so-called level ditches ran across the fields on slight grades. They delivered water to downhill ditches or watercourses spaced 35 to 70 feet apart. Water was delivered from these ditches into large contour furrows in which the sugar cane was planted. Each furrow was filled with water to a depth of 4 to 10 inches. With the short lengths of run and the ponded water, efficiency of water application must have been very good, particularly in young cane. One man could irrigate about an acre a day with this system.

During the 1920's rising labor costs caused plantation owners to modify the contour system or develop systems with graded furrows. Present day systems include: The herringbone system, the continuous long-line system, and the modified level ditch system.

#### *Herringbone System*

The herringbone system gets its name from its similarity to a fish skeleton. A ditch, flume, or pipeline is the backbone and runs downslope. At most plantations these backbone lines are concrete flumes having metal slide headgates along both sides. This type of flume was developed by the Waialua Agricultural Company in 1935 and is known as Waialua flume. Flume lines are spaced every 300 to 500 feet and water from them flows into

[1] *Colocasia esculenta* is a plant grown throughout the tropics for its edible tuberous rootstocks. In temperate regions it is known as elephant's ear and is grown for ornamentation.

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large furrows grading away from both sides of the flume to a level area midway between flumes. Hence, the irrigation furrow runs are only half as long as the distance between flumes. No outlet is provided for irrigation tail water. With this system, using concrete flumes and a head of 7 million gallons of water per day (10.9 cubic feet per second), an irrigator can water about 12 acres of sugar cane in 8 hours.

About 1935 the Pioneer Mill Company on Maui developed a concrete pipe with gated outlets for the backbone of their herringbone system. Pipe was used because land slopes were as steep as 24 percent and too much water splashed out of an open flume. Offset drop outlets with sliding metal gates on both sides of the pipes were used to control the water entering the furrows. Average pipeline spacing is 300 feet with this system, and an irrigator can water 8 acres per man-day.

The herringbone system has a distinct disadvantage during periods of intense rainfall for runoff accumulates in the level portion of the furrows midway between the flumes. When one furrow near the top of the slope overtops, a chain reaction sets in and water, soil, and sugar cane flow downhill. Some plantations install drainage ditches at the midpoint between flumes in order to reduce storm damage in event of a breakout. The Pioneer Mill Company installs roadways at this midpoint in the herringbone system; thus, soil loss and damage during storms is reduced, repairs can be more easily made, and better field access is provided.

### *Continuous Long-line System*

The continuous long-line system utilizing aluminum flumes was developed by the Olokele Sugar Company on Kauai. Furrows are usually on a 1 percent grade and may be up to 2,000 feet long. Flumes 300 to 500 feet long are laid downslope across the furrows at intervals of 300 feet along the furrow. Orifices in the bottom of the flume deliver water to each furrow. These need little regulation and the system is nearly automatic. As the crop grows, resistance to flow in the furrow increases and larger heads are required. Up to 70 gallons of water per minute may be delivered from a single outlet. From 10 to 20 acres may be irrigated per man-day with this system. Concrete instead of aluminum flumes are sometimes used at the upper end of the furrows.

The continuous long-line systems are better adapted to the soils having lower intake rates. With this system the furrows serve as diversions for conveying storm runoff from the fields in an orderly manner. For soils with high intake rates the herringbone system is much more efficient.

### *Level Ditch System*

The level ditch system consists of ditches and furrows. Actually, the so-called level ditches are field laterals on grades of 0.1 to 0.5 percent. The furrows are 250 to 300 feet long on grades ranging from 0.8 to 2.5 percent. This system is used on slopes up to 12 percent and with it an irrigator can water 6 or 7 acres in a day.

Last year some large size level ditches were installed by the Hawaiian Commercial and Sugar Company on Maui. These ditches actually *are* level. Spiles three inches in diameter are set in the banks. Furrows are 250 feet long. Large heads of water are turned into the ditches and travel rapidly through the furrows. Part of the water application efficiency that was lost in some departures from the original watercourse system has been regained with this level ditch system. Water regulation is at a minimum and one man can irrigate up to 25 acres in a day without undue strain.

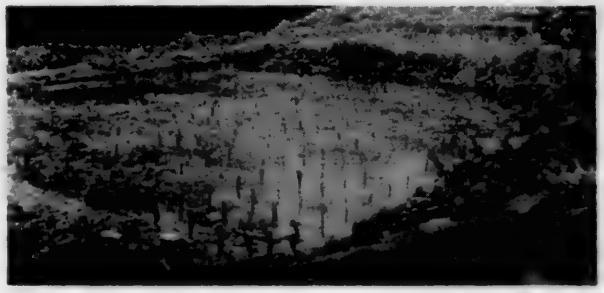
## Sprinkler Irrigation of Sugar Cane

Irrigation by overhead methods was tried by the Kohala Sugar Company on Hawaii in the 1920's, but available equipment could not cope with the wind and crop conditions. Today, less than 3,000 acres of sugar cane are irrigated with sprinklers, and the equipment used varies widely. Adaptation of equipment is still largely experimental. Many field tests to determine design criteria are being conducted.

Since 1953 Kohala Sugar Company has used a portable "hand-move" system on 400 acres of land that needs only three to six rounds of irrigation during the 2-year cycle of cane production. Recently they have changed from the individual risers and 1⅛-inch diameter nozzles to large rotating boom sprinklers.

From 1955 to 1958 Oahu Sugar Company on Oahu and Hawaiian Commercial and Sugar Company on Maui used "tow-wheel" equipment on a total of 250 acres. Wind conditions, wide sprinkler spacings, and numerous equipment breakdowns resulted in poor water distribution and reduced cane yields. These systems were discarded. Currently the Hawaiian Commercial and Sugar Company has about 25 acres under semi-permanent full coverage systems that have automatic sequencing valves.

**Figure 1. A taro patch is leveled, planted and irrigated today in much the same manner as it was when Captain Cook described them in 1778.** *SCS Photo*



SCS Photo

**Figure 2. The giant sprinkler developed at the Ewa Plantation Company. Wind velocity was 10 miles per hour when this picture was taken. The cost of this machine was approximately $25,000.**

Kilauea Sugar Company on Kauai has six rotating boom sprinklers and two large volume guns. Over half of their irrigated acreage is now under overhead irrigation. Paauhau Sugar Company on Hawaii also has two rotating boom sprinklers.

Ewa Plantation Company on Oahu has a completely new trailer-mounted giant sprinkler (figure 2). It delivers 2,700 gallon per minute at a pressure of 115 pounds per square inch. A 250-horsepower engine drives the centrifugal pump. The sprinkler has two interesting features—a tilting head and an arc control. On windy days the axis of rotation is adjusted so that the nozzle is lowest when shooting into the wind. Water distribution patterns are markedly improved because of this feature. Point application rates under single sprinkler operation do not exceed 1.5 inches per hour. Reversing stops are set to give arc control, and only 270 to 300 degrees of a full circle are wetted at any one nozzle setting. This counter-rotation device avoids wetting the roads.

Development of the 3⅛-inch diameter nozzle was a problem. First, a giant nozzle that would get a maximum of throw distance combined with good stream break-up had to be developed. Then, the amount of axis rotation tilt, wind velocity, and water distribution pattern relationships had to be established. Engineers at Ewa Plantation Company indicate that with the nozzle correctly in use a 450-foot road spacing is satisfactory under the wind conditions at that location. Stream break-up is important so that detrimental soil compaction, aggregate breakdown, and puddling can be avoided. Further experimentation is necessary to determine whether the stream break-up is adequate for the soils on Oahu.

A smaller sprinkler using the same design principles has also been developed. Cost of this sprinkler is about $2,500. The cost of typical systems complete with pump, motor, pipe, and sprinklers capable of applying 3 inches of water every 10 days is about $80 per acre.

SCS Photo

**Figure 3. Lanai irrigator delivers 850 gallons of water per minute through two 132-foot booms.**

## Pineapple Irrigation

Irrigation of pineapple is relatively new in Hawaii. Experimental work was started in 1937 but it was not until 1949 that field scale operations were begun. The pioneer work was started by the Hawaiian Pineapple Company (now the Dole Corporation) on the island of Lanai. High water development costs, limited water supplies, low consumptive use, low water requirements, a block field layout pattern, and shallow rooting are factors in equipment design. The pineapple is a miserly water user and produces well on less than a third of the amount of water required by sugar cane or alfalfa. In low rainfall areas large increases in yield may be obtained by applying small quantities of water.

To meet this unusual set of conditions special sprinkling machines were designed and constructed. Dole's largest machine (figure 3) is worthy of description. Two spray booms each 132 feet long are attached to the sides of a large truck. One thousand feet of 5-inch diameter hose is rolled up on a huge reel mounted on the truck. This hose delivers 850 gallons of water per minute to the nozzles. As the truck moves along the field road, the hose is unreeled. On the return trip the reel rewinds the hose like a giant winch. About 10 passes are made to apply 1 inch of water to the pineapple plants. The operator adjusts the boom height with a network of cables. Very good water application efficiencies are obtained for an acre can be irrigated in 35 to 40 minutes.

At Dole's plantation on Oahu, rotating boom sprinklers are used. On Molokai, the California Packing Corporation pumps water almost 1,000 feet from the basal water table[2] and distributes it through a two-man Lanai-type

[2] Basal water is ground water floating on salt water and is either under artesian pressure or has a free water table.

machine. The cost of water and application are high, but increased crop returns make this system economically feasible.

Aluminum sprinkler systems moved by hand are also used on a small scale, and tank trucks with spray booms have been used at times. No surface irrigation of pineapple has been employed on a field basis.

### Irrigation of Other Crops

Truck, orchard, and pasture crops are irrigated either with furrows or by sprinklers. Most of the sprinkler systems are the portable type that are moved by hand. Rotating-boom and large volume nozzle sprinklers are also used on pasture lands.

Water crops are raised in level basins bounded with low levees. Taro, rice, watercress, lotus root, and water chestnut are grown. A continuous flow of 1.5 cubic feet per second per acre is required to produce good quality watercress. On Oahu, several large springs in the vicinity of Pearl City have a combined flow of 40 to 60 million gallons per day (62 to 93 cubic feet per second). Part of this water is used to irrigate about 30 acres of watercress, lotus root, and water chestnut before it flows into Pearl Harbor.

Irrigation has been improved in many places by the installation of small overnight storage reservoirs. These have been extremely advantageous on the truck crop and orchard farms where only small flows are available. In addition to reducing labor requirements and improving water application efficiencies, these reservoirs have helped increase yields because better use is made of the water available. A typical small reservoir holds about 150,000 gallons of water. Many of them have been lined with an asphalt membrane. This costs about $2,000 for the 5,500 square feet of lining needed. These costs reflect the high value of water in some parts of Hawaii.

# A Quarter Century with Soil Conservation Districts

WILLIAM A. BENITT

***On August 4, 1937, the first soil conservation district was organized in the United States. Portions of Anson and Union Counties in North Carolina were included within this district's boundaries. Only 2 years earlier, on April 27, 1935, the Federal Government had initiated an organized program of soil conservation by creating the Soil Conservation Service, an agency in the Department of Agriculture. In this article the developmental philosophy of the soil conservation movement is briefly traced and some responsibilities that districts and district leaders must assume are succinctly presented.***

AN ANNIVERSARY is always a good time for taking stock of one's self. By measuring past accomplishments against potential achievement we can more easily see from whence we have come and be better able to predict and plan the course ahead. Recently the 25th anniversary of the creation of the Soil Conservation Service was celebrated, and soon the first soil conservation district will observe its 25th year. This, then, is a most opportune time to take stock of the performance and assess the potentialities of soil conservation districts.

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*This article is a revision of the keynote address delivered by the author last year at the Midwest Meeting of State Soil Conservation Committees, Boards and Commissions at Higgins Lake, Michigan.*

Slightly more than 50 years ago, on September 10, 1910, the second National Conservation Congress was held in St. Paul. Speakers at this meeting included Theodore Roosevelt, former president of the United States; President William Howard Taft; and Gifford Pinchot, conservation leader instrumental in establishing the Forest Service in 1905.

In his keynote address to the Congress, Great Northern Railroad builder, J. J. Hill said, "There remains an opportunity and a need of conservation transcending in value all others combined. The soil is the ultimate employer of all industry and the greatest source of all wealth. It is the universal banker. Upon the maintenance, unimpaired in quantity and quality of the tillable area of the country, its whole future is conditioned."

When J. J. Hill made this eloquent plea in 1910, much of the Upper Midwest had not been farmed very long. Little creases were just beginning to appear on the land and an occasional gully could be found. Soil nutrients were not conspicuously lacking.

*SCS Photo by Robinson*

**Action programs of soil conservation instigated by local people were underway in many parts of the nation when this group of conservationists met at Clemson College in 1941. (Left to right) Dr. T. S. Buie, regional conservator, Soil Conservation Service; E. C. McArthur, chairman, South Carolina State Soil Conservation Committee; Dr. H. H. Bennett, Chief, Soil Conservation Service; D. W. Watkins, director of the Extension Service and Ernest Carnes, state coordinator, Soil Conservation Service.**

Professor Milton Whitney of the United States Department of Agriculture wrote an article for the December 3, 1910, issue of *The Farmer;* this article brought together the results of 1,769 potato fertilizer trials conducted at 23 stations throughout the United States. "Although there was considerable variation in the yields of check plots as compared to fertilized plots in the same field," he wrote, "there appears to be a good chance to obtain an increase of the crop by the application of fertilizer." Just a "good chance"?

Use of fertilizer other than manure is but a recent development. W. P. Martin of the University of Minnesota gives evidence that fertilizer consumption in Minnesota rose from 5,000 tons in 1926 to 371,000 tons in 1956. This bespeaks a recognition of decreasing productivity unless additional nutrients are supplied.

In 1905, a young chemistry graduate who was engaged in soil mapping and classification entered the conservation arena. This man who single-handedly altered the course of agricultural technology perhaps more than any other person was Hugh Hammond Bennett. He and a companion observed two plots of land that lay side by side on the same slope. The underlying rock was identical and all evidence indicated that soil characteristics on the two plots had once been similar. The soil in the wooded area was mellow, moist loam. The surface soil on the adjoining cultivated area was clay which was hard and like a rock when dry. Since there had been no erosion in the wooded area, Dr. Bennett concluded that both areas had originally been identical and that the clay of the cultivated area was really subsoil that had been reached through the removal of the topsoil.

There is nothing startling about this discovery today, but the United States Department of Agriculture squelched this young chemist, just 2 years out of college. In Bulletin Number 55, issued in 1909, the chief of the Bureau of Soils stated: "The soil is the one indestructible, immutable asset that the Nation possesses. It is the one resource that cannot be exhausted." Some time later Dr. Bennett observed, "I did not know so much costly misinformation could be put into one brief sentence."

Not until the drought years of the late twenties and early thirties, when the dust storms on the Great Plains blotted out the sun over Washington, D. C. and created a haze over Wall Street, was there any general awareness of soil losses.

## The Dark and Dirty Thirties

Robert D. Lusk vividly describes the history of the Karnstrum farm in South Dakota in his article, "The Life and Death of 470 Acres," which appeared in the *Saturday Evening Post* on August 13, 1938. The story in brief—homestead entry was made in the early eighties—the land sold successively for $8, $15, $32, and $39 an acre—the farm netted around $8,000 a year during World War I—it was mortgaged to build a house in town and mortgaged again to buy additional acreage.

But the drought years of the late twenties and early thirties reduced crop yields, and prices of farm products declined drastically. Dust storms swept the area and piled soil and sand over fences, fields and buildings. Interest payments were soon in arrears and tax payments became delinquent. The mortgage was foreclosed and was bid in for less than half the price the owners had paid 28 years earlier.

This setting multiplied by many farms and ranches was the precursor of national farm and soil conservation legislation. And the states also enacted laws giving farmers and ranchers authority to organize districts specifically for the conservation of soil and water resources.

## District Philosophy

What was the philosophy and thinking that brought about the birth of soil conservation districts—sovereign, autonomous, independent units of local government?

Like the good football coach who drills his charges on fundamentals—blocking and tackling—before proceeding to the razzle-dazzle stuff, the strength of a soil conservation district stems from fundamentals.

First, the district is created by local people under enabling state legislation. Except in Wisconsin, land operators petition for the formation of a district and it becomes an entity only after certain hearings, a referendum and election of board members. It is a democratic, grass-roots, local unit of government. Local people determine whether they want it, delineate district boundaries, elect their own board members, and determine district policy. Districts are responsible only to the people within their boundaries.

Second, the district is given a wide range of powers, express and implied. Among the dozen or so powers specifically delegated to it, the district board is authorized to "cooperate or enter into agreements with any agency, government or otherwise, or any occupier of lands in carrying on erosion control or prevention operations."

*Third, soil conservation districts are action agencies. They have been given the job of getting soil and water conservation on the land and that is solely and primarily their responsibility. In short, local people are the boss, the responsibility for getting the job done is theirs and theirs alone. Work on which the Soil Conservation Service or any other agency cooperates with a soil conservation district is not a joint responsibility. It is a responsibility of the district, and the memorandum of understanding which each district has with the Secretary of Agriculture clearly imposes on the district the duty to provide leadership in soil and water conservation.*

*SCS Photo by Finley*

**In 1935, Hugh Hammond Bennett had begun to make an impression on Americans as he directed their attention to the fateful consequences of soil erosion. Here he holds a young locust tree planted to halt further destruction of an already severely eroded soil near York, South Carolina.**

## District Leadership

The president of a construction company does not shovel sand and gravel nor does the president of General Motors spend his time in the shops assembling cars. But these people are responsible for recruiting the men and talent to do the various jobs and produce a finished product. Likewise, leadership of the district board does not mean laying out contour lines or preparing watershed plans. Leadership means marshalling the resources that are available and putting them to effective use.

One of the big jobs facing district leaders is to change the thinking of the people of America and to translate that changed thinking into action. Public temperament is like a balky mule. There is nothing wrong with his legs, it's his mental attitude that's at fault. The present mental attitudes of people and their past thinking cannot be wiped out summarily as one erases the writing on a slate, but there is a pressing need to change the thinking and habits of people from one of waste and spoliation to one of wise use, not only for the present, but with regard for the future. But before districts can lead, they must attract the confidence of others.

Not many people are going to be blind followers of a soil conservation district; they want and have a right to know what it is all about. Until a district has a program and work plan that is up-to-date, recognizes that this is 1961 and not 1935, and attacks today's district problems in the light of today's situations, followers will not be attracted in great numbers. This is one of the great needs of the soil conservation program during the next decade—to periodically review and bring up-to-date the district program and work plan.

One reason, among others, for this review is that there are new members on the district governing body who have had no part in forming the district program. These new members would work much more effectively if the program was their own, one they helped develop.

The board of a soil conservation district is not unlike the board of directors of a corporation. The board makes the policy decisions and manages the affairs of the corporation. In part at least, its job is to keep abreast of the changing times. The Ford Motor Company revolutionized travel when it came out with its famous Model T. It was *the* automobile for quite a spell, but in the twenties the board decided that it was time for a change, and the Model A took its place.

Soil conservation districts must be as alert to changing times as are corporate directors. One cannot sell a Model T conservation program and work plan to an electronic and jet-minded public any more than one can sell "merry widow" hats or two-seated top buggies on main street today. In exercising the obligation of leadership and in gaining support, districts will not succeed too well unless they have the latest model program.

Most districts are now at least 10 years old, a goodly number are over 15 and many are 20 years of age. A program and work plan was fashioned at the time each district was formed. A copy was mailed to the land operators and the office copy filed. But since then the program has been looked at rarely. The district signed a memorandum of understanding with the Secretary of Agriculture and technical assistance was provided. The

Agricultural Extension Service agreed to do some educational work.

Now suppose this board called together all the agencies and groups that today are interested in and concerned with the many and varied fields of conservation. Might they not arrive at quite a different program and work plan? Today one would call in all Federal, state, county, and local governmental bodies and agencies. It would be well to solicit the help of women's groups, business organizations, farm organizations, church groups, sportsmen, nature lovers, and many others. Also needed are the newspaper editors as well as representatives of the industries serving farmers—banks, fertilizer, feed, and machinery dealers.

Once the representatives of all these groups become actively involved in the planning, the result will be a good cross section of the kind of program which is most feasible and a work plan will be developed that fits into or can become a part of the programs of these groups. Cooperation is likely to be forthcoming in real and tangible ways from this type of conference; not the kind of cooperation that just means "we ain't fightin," but a real understanding of conservation in its many facets, and perhaps large numbers of people can be activated into real conservation work.

Many concrete examples of cooperation can be cited. One large farm organization is operating a complete fertilizer service; this includes soil tests, fertilizer recommendations based on the tests, tissue tests of the crops during growing season, yield checks, and educational meetings during the winter. Likewise, many feed manufacturers now provide complete feeding programs and service that all but guarantee profitable results. Another farm organization has an electronic accounting and records analysis service. In some areas crop improvement associations have employed men to take soil samples for farmers.

The district board can exercise leadership by getting these organizations or associations to fit soil and water conservation into their established programs. Board members alone cannot do the job, but there are many who are not only willing but anxious to be of assistance. Calling on these people and on various organizations for help will put more members on the conservation team. Marshalling these forces in behalf of conservation endeavors is a real exercise of leadership.

### The Decade Ahead

One thing that needs to be guarded against in the decade ahead is the tendency of districts to abrogate leadership—to rely on others too extensively. Do the technicians or field men tell boards what to do or are they there in an advisory capacity only? This does not mean that boards should fail to take counsel and get all the information possible from all available sources, but the ultimate decision should be that of the board of the district. The board should not become a rubber stamp for any agency.

We should always remember that the soil conservation district endeavors to solve conservation problems through group community action. The initiative and the push must come from districts and the success or failure of their projects belongs only to the district. The danger is that soil conservation districts lean too heavily on willing advisors and do not really make the policy decisions themselves. But, policy determination does not mean that district boards shall determine the hours that the county agent or the work unit conservationist shall work or how vocational agriculture shall be taught.

Another matter of growing concern to district leaders is that considered under the broad heading of winning and keeping public acceptance. An up-to-date program and work plan is of paramount importance. District people need constantly to familiarize themselves with their own district, and their district plan must reflect the changing times and techniques. As districts grow older, they will be criticized. Listen to criticism; determine whether or not it is valid, and if it is justified find out if there is anything that can be done about it and whether or not anything should be done. Complaints are often the result of misinformation. It is important that the public understand what districts are trying to accomplish and that correct information is available to them.

Good relations with the press are important. In the thirties, conservation had very good press coverage. Subsequently, fertilizers, herbicides, antibiotics, labor-saving machinery, economics, taxation, and record keeping have driven soil conservation from the headlines. Now one may occasionally find news articles critical of soil conservation activities because waterfowl rearing areas are destroyed through drainage of agricultural land. But an occasional critical press may not be as serious as a press that overlooks entirely the activities and efforts of soil conservation districts. To win and keep public acceptance, we need the press; but the press will publish items only if they are newsworthy. It is up to us to make the news, not for the press to create it. If we want the people to conserve soil and water we must inform them.

Another note of caution—districts must not be stampeded into embarking on remotely related projects or hurried unduly in their work. We are all impatient to make more rapid progress, but we are dealing with people and we cannot move faster than people are willing and able to go. Critics may shout, "You have been at this soil conservation now for 25 years! Why aren't you

finished with the job?" Just remember, it takes more than one sermon to convert a heathen, and Christians have a sermon preached to them every week. The basic job of the district is to see that farms are planned and the plans applied to conserve soil and water. Let us not be diverted to related extraneous projects. We are cooperators not competitors.

*Des Moines Register Photo*

**More than 70,000 people at the national soil conservation field day and plowing match held on September 15, 1949, watched as J. S. Russell, (far left), farm editor of the Des Moines Register and Tribune and president of the Society in 1957, presented awards to seven top conservationists. (Left to right) Russell; Kent Leavitt, president, National Association of Soil Conservation Districts; Julius Lench, Harlan, Iowa; William A. Benitt, the author of this article; Donald Pharis, Liberty, Missouri; Kenneth Ralston, Roscoe, Illinois; Everett M. Barr, president, Nebraska Association of Soil Conservation Districts; and Hugh Hammond Bennett, Chief, U. S. Soil Conservation Service.**

What does all this portend for the decade ahead? Statistics show that farms are getting larger and will continue to grow in size. Fewer people will be engaged in farming but agricultural production will increase. Larger machinery is in the offing. One Minnesota farmer is now using an eight-row corn cultivator and with this machine 200 acres a day can be cultivated. More fertilizer will be used. Herbicides give rise to the hope that soon the only operations necessary to grow corn will be planting and harvesting. Antibiotics are rapidly altering the amount of feed required by livestock. Services rendered by industries and farm organizations to farmers will probably expand.

How will the soil and water programs adjust to these developments? How will the eight-row corn cultivator function on strips, terraces or contour point rows? Are fertilizers and herbicides with their spectacular results going to overshadow, at least temporarily, the need to employ the soil and water conservation measures which today are thought not only necessary but imperative?

There are also some black and ominous clouds on the horizon. The decade ahead probably will not be one of easy living. Sharp barbs are thrown at farm drainage—if perchance, it might destroy some duck nesting areas. The duck hunters are aggressive people, dedicated to keeping all potholes and wetlands as they are. They have little sympathy for a soil and water conservation program where farm drainage is involved.

## Liberty and Freedom

What does this all mean in terms of an ultimate objective for districts? Simply, people and their welfare. Not only are we concerned that people have enough food, clothing and shelter, but also important is how these objectives are achieved. There is an institution in our state where people are provided with all their physical needs: ample and good food, comfortable beds and quarters, job security, care in old age, medical and dental care, and recreation and entertainment; but not many like it there and most would prefer to leave. It is the Minnesota State Prison. Provision is made for all the needs of folks who live in that institution. Freedom and liberty is all that they lack.

If the local people, through their local, democratic units of government fail to do their job, it does not follow that the conservation program will also fail, but it may and probably will mean that local people will have little to say about conservation programs and control will be just a bit farther away from home. If this is allowed to happen another vestige of liberty will have been removed.

This Nation was founded at a time when the world was pretty much hostile to the idea of freedom. A large part of the world is still hostile to the idea. If freedom is to survive, enough people will have to care about it, and soil conservation district people should be in the vanguard of those who care and act. Might not this be the occasion when all together we may again as one people rise to great heights as we dedicate ourselves to conserving the soils and the waters of this Nation? This is the challenge of leadership!

**The Plant Community.** *By* HERBERT C. HANSON *and* ETHAN D. CHURCHILL. *218 pp., illus., index, 1961. Reinhold Publishing Company, 430 Park Avenue, New York 22, N. Y. $4.95. (Reviewed by* STANLEY A. CAIN, *Ann Arbor, Michigan.)*

The authors intend this book as a one-term text in plant ecology. Considering the plant community to be basic to an understanding of vegetation and to many kinds of pure and applied ecological investigation, and believing that textbooks in general ecology do not treat the community adequately, the authors have prepared their book to fill the gap at the introductory level of ecological study.

The presentation is in four logical parts: Species and populations, the community, dynamics of communities, and classification of communities. Commencing with a very concise statement of principles concerning the relations of species to the physical environment (without quantitative illustrative data, but with a variety of examples of species occurrence and behavior in relation to physical environment) and of the relations among individuals (which have a genetic basis, but not illustrated by data on specific genetic situations), the text then takes up the community, per se. Here one finds a consideration of several quantitative and qualitative characteristics of communities that are analytic in nature, such as species composition and various aspects of community structure (life-form, periodicity, gregariousness, etc., and density, cover, frequency, mass, etc.).

In the third part the discussion of the dynamics of vegetation includes an examination of cyclic changes as well as progressive changes, an interesting feature of the treatment, culminating logically in a consideration of the climax. Finally, there is an interesting and provocative (perhaps to some readers, provoking) discussion of the bases of community classification. At one point one believes that the authors have committed themselves, for one reads "that vegetation should be characterized by its own properties and not by extrinsic data. . . . The environment is a controlling influence, not a property, of vegetation . . ." (pp. 172-173), yet later they say ". . . a complete, scientific classification requires consideration of species composition, in addition to the other analytic and synthetic characteristics, of the various kinds of stands occurring in each group distinguished by any of the last four major criteria listed above," (pp. 177-178), which include ecological relations or habitat. One is back, then, to such criteria of communities as are related to altitude, oceanicity, soil characteristics, etc., which certainly are extrinsic factors. At other points one wonders somewhat about meaning. Take for example, the statement: "Classification on the basis of ecological relations (synecology) has been widely used." "Ecological relations" and "synecology" certainly aren't the same thing. What about the relations dealt with in autecology? Although occasionally ambiguous, the writing is usually clear and the ideas being dealt with are usually comprehensible to the beginning student of ecology, and that is no small accomplishment. This book should be recommended for what it is intended, and not criticised for what it doesn't purport to be. It deals with the nature of plant communities in an interesting and useful way. Ecologists generally can read it with profit and teachers will find it useful.

**Our Soils and Their Management.** *By* ROY L. DONAHUE. *Second edition, 568 pp., appendices, index, 1961. The Interstate Printers and Publishers, Inc., 19 North Jackson Street, Danville, Illinois. (Reviewed by O. W.* BIDWELL, *Manhattan, Kansas.)*

"Nothing in my opinion would contribute more to the welfare of the States than the proper management of the lands." Roy L. Donahue's use of this quotation by George Washington as an introduction to the chapter, "Managing Soils and Water for Field Crops," typifies the punctilious and discerning care that has been used in this revision of the 1955 edition of *Our Soils and Their Management*.

In addition to refinements that include the use of a larger number of better illustrations, precise definitions and more recent information, the author has added four chapters and rearranged the subject matter into a more usable form. Chapter summaries are a new feature and Donahue has also added appendices that include the names and addresses of the state agricultural experiment stations and state Soil Conservation Service offices, conversion factors, and definitions of terms.

Originally written for vocational agriculture instructors and students, the revised edition appears to be directed more to the instructors and adult readers. Although it has much value as a reference book for the vocational agriculture student, it is probably too comprehensive and perhaps somewhat too technical for his daily use. As revised, it would make an excellent addition to the library of any agricultural worker—teacher, county agent, or work unit conservationist.

Few authors have had the wide experience of Dr. Donahue, whose travels and work have taken him to Portugal, Greece, Turkey, Iran, the Philippines, Japan, and South America. He is currently working with the Ford Foundation in India. These experiences, in addition to his having lived and worked in Michigan, Illinois, New York, New Hampshire, Mississippi, Kansas, and Texas, have given him an appreciation for soils and their management that few men can match. Surely these experiences abroad have given his book an authority that normally comes only after many revisions, and many, many years of experience.

Seven chapters have been included on the management of soil and water for specified land uses. In addition to the chapter on the management of soils and water for field crops, one chapter each is accorded gardens, lawns, pastures, rangelands, orchards, and forests. Many persons, particularly those lacking the knowledge of the basic principles of soil management, will find these chapters on application useful.

**Western Forest Industry—An Economic Outlook.** *By* JOHN A. GUTHRIE *and* GEORGE R. ARMSTRONG. *324 pp., illus., index, 1961. The Johns Hopkins Press, Baltimore 18, Maryland. $6.50. (Reviewed by* DAVID P. WORLEY, *Flagstaff, Arizona.)*

This book describes an aggregative study of major western timber based industries not dissimilar in content from various national timber surveys. Projections are made to 1975 from basic data appearing in numerous reports. These projections result from mathematical regression techniques tempered with a visual extrapolation of historical data. Additional perspective was gained during field trips and by interviewing informed representatives of colleges, industry, government agencies, and trade associations. The main point of departure from the national surveys is the regional viewpoint.

The western forests are divided into three sub-regions—the coastal area, the intermountain area, and the interior of Alaska and British Columbia—to simplify an otherwise very complex picture of the Pacific slope and its forest resources. Three timbering industries are considered throughout the book, the lumber industry, the pulp and paper industry and the plywood industry. These are analyzed in each sub-region to explain the geographical and organizational changes in each as revealed by the statistics. The shift in the pulpwood industry, for example, from sulphite to sulfate processes, is ascribed to the fact that more species can be handled by the latter method, to technological improvements in the bleaching process for sulfate pulp, and to simplified procedures for handling sulfate residues so as to abate stream pollution.

Based on these discussions of the region, its forests, its industry and the historical sequence that created current conditions, projections of demand and supply are made to 1975. Analysis of demand centers around consumption and production projections for each of the major industries so as to suggest how they might develop. Discussion of the supply question emphasizes the price trend and government policy adjustments to take up the slack in supply created by cutover private lands.

Discussion of certain restricted aspects of government land management policy is followed by a very interesting discussion of sustained yield and allowable cut. The principle of sustained yield is considered from the viewpoint of the private timber landowner, from the public viewpoint, and through the eyes of the timber processors.

This stimulating section of the book perhaps provokes more ideas than it contains since it considers forest land policy only from the standpoint of wood production. The effects of other facets of land use on timber supply are hardly mentioned nor is the effect of wood substitutes on demand treated extensively. Very interesting implications are drawn in the restricted analysis.

This worthwhile book should find its place on the desks of foresters and administrators in the resource field. It is excellently documented. Many important problems and considerations which affect the western forest resources are set forth in a clear, readable style. The book concludes on an optomistic note by pointing to lines of alternative action likely to lead to improving forest industry.

**Seeds — The Yearbook of Agriculture, 1961.** ALFRED STEFFERUD, *Editor. 591 pp., illus., glossary, index, 1961. U. S. Government Printing Office, Washington 25, D. C. $2.00. (Reviewed by* O. M. MCCONKEY, *Elora, Ontario, Canada.)*

*Seeds* is another major contribution in the series of Yearbooks devoted to a single broad segment of agriculture and agricultural science.

This series was started in 1936 during the regime of Secretary Wallace. As a Canadian I would like to pay tribute to the mind or minds that originated the idea of publishing this series of books which individually deal with a definite subject. The series has made a great contribution to agriculture; the books are used as reference texts throughout the world.

*Seeds* contains 75 chapters and 48 pages of photographs and other illustrations. It was written by 128 men who are specialists in their fields. There are seven main sections in the book: "The Importance of Seeds," "The Life Processes of Seeds," "The Production of Seeds," "The Processing of Seeds," "The Certification of Seeds," "The Treating of Seeds," and "The Marketing of Seeds."

The 591 pages of text cover the gamut of salient points about seeds; the book is at once a scientific and practical reference work. It is also an important contribution to World Seed Year and the search by the peoples of the world for freedom from hunger.

# Current Literature Briefs

**Introduction to the Study of Animal Populations.** By *H. G. Andrewartha.* 281 pp., bibl., index, 1961. The University of Chicago Press, 5750 Ellis Avenue, Chicago 37, Illinois. $5.00.

The ways in which the environment may influence an animal's chance to survive and multiply are discussed in relation to weather, food, a place to live, and other animals and pathogens, in Part I of this work on animal ecology. It furnishes the theoretical background for Part II (75 pages). In this section, "experiments" or exercises dealing with methods for measuring the distribution, density, and dispersal rate of animals in natural populations and animal's responses to particular components of environment are described.

**The State of Food and Agriculture 1961.** Food and Agriculture Organization of the United Nations. 177 pp., paperback, 8¼ x 11 in., 1961. Available from FAO Sales Agents; in the U. S. from International Documents Service, Columbia University Press, 2960 Broadway, New York 27, N. Y. $2.00.

In addition to the usual review of the recent world food and agricultural situation, this volume contains two special chapters; one is concerned with land reform and institutional changes in various parts of the world and the other deals with agricultural extension, education, and research services in Africa, Asia, and Latin America. The text of this work reports that the world's population grew faster than did its production of food and agricultural goods during 1960-1961.

**Weed Control: As a Science.** *Glenn C. Klingman.* 421 pp., illus., refs., index, appendix, 1961. John Wiley & Sons, Inc., 440 Park Avenue South, New York 16, N.Y. $8.50.

Herbicide development during the past 15 years has resulted in a proliferation of new products. A practical text such as this one has been sorely neded to bring together in usable form data concerning chemicals for weed control and their practical application.

The first seven chapters of the book include discussions of methods by which weeds spread, seed dormancy, plant physiology and herbicides, wetting agents, emulsifiers, spreaders, stickers, various chemical formulations, spray drift, equipment for application, and practice in chemical calculations.

The next seven chapters are devoted to description of chemical and physical properties of at least 25 herbicides, their effects on plants, and their toxicity to man and animals as well as mention of their most important uses.

The practical application of weed control is treated in the final ten chapters. Weed control in all types of crops, including pastures and range, as well as elimination of undesirable brush and trees is presented. Aquatic weed control, soil sterilants and weed control in lawn and turf are also discussed in separate chapters.

In addition to its suitability as a college class text, anyone interested in a practical reference on weed control will find this book valuable.

**Natural Resources and Economic Growth.** *Joseph J. Spengler,* Editor. 306 pp., 1961. Resources for the Future, Inc., 1775 Massachusetts Avenue N. W., Washington 6, D. C. $3.50.

The papers composing this volume were presented at a conference held at Ann Arbor, Michigan, April 7-9, 1960, under the joint auspices of Resources for the Future, Inc., and the Committee on Economic Growth of the Social Science Research Council. The primary purpose of the conference was to assess the role played by land and other natural resources in economic development.

**Land, Water and People.** By *Otis Tossett,* assisted by *Joe Douthit.* 143 pp., illus., 1961. The Soil Conservation Districts Foundation, Inc., League City, Texas. $3.00.

Two men, well-known in soil conservation district circles, sketch the history of the National Association of Soil Conservation Districts in this book. Programs the Association has helped to develop are described and the names of leading participants recorded. The 62-page appendix includes a statement of the objectives and policies of the Association, a list of the officers by years, and the Association's annual meeting programs from 1947 through 1960.

**United Nations Register of National Parks and Equivalent Reserves.** 301 pp., mimeo., 1961. United States Mission to the United Nations, 799 United Nations Plaza, New York 17, N.Y. (Single copies free).

This document is the first part of a study prepared in response to a United Nations Social and Economic Council resolution. It contains descriptive accounts and tabulations of information submitted by 52 countries. The second part of the document will be a continuing supplement adding new data from these nations and other countries.

**Havoc—The Story of Natural Disasters.** By *William Bixby.* 180 pp., 1961. Longmans, Green and Co., Inc., 119 West 40th Street, New York 18, N. Y. $3.50.

This book describes the reaction of people and the destruction caused by some of the fearful natural disasters known to the modern world. Hurricanes, floods, earthquakes, and volcanic erruptions, together with a brief description of their natural causes, are among the cataclysms of nature that the author describes.

**Exploring the Seacoast.** By *John Perry* and *Jane Greverus Perry.* 185 pp., illus., 1961. McGraw Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y.

In this well-written book, a companion volume to *Exploring the River,* the authors show the reader how to make his own discoveries of the natural phenomena in this area of infinite variety—the seacoast. The text does a masterful job of introducing and explaining to young readers the wide variety of natural forces affecting the seacoasts. The reader is also expertly introduced to several species of plants and animals normally found along the coast.

**Trails of His Own.** By *Adrienne Grossman* and *Valerie Beardwood.* 206 pp., 1961. Junior Books Department, Longmans, Green and Co., Inc., 119 West 40th Street, New York 18, N. Y. $3.95.

This fictionalized biography of John Muir and his fight to save the national parks will enchant young people and perhaps inspire them to learn more of nature's wonders and beauty. Adults will find it a vivid account of Conservation's eternal struggle against man's inclination to destroy and disrupt his environment.

**Anyone Can Live Off the Land.** By *James Ralph Johnson.* 121 pp., 1961. Longmans, Green and Co., Inc., 119 West 40th Street, New York 18, N. Y. $2.95.

In this practical book about how to survive in the wilderness, the author points out many little tricks: how to use the elder leaf to neutralize poison ivy; where to find fish poisons as effective as those used by tropical natives; how to preserve game fish; how to make pots and pans; how to get "water" from plants; and many other bits of knowledge of woodlore that few boys, or men for that matter, have the opportunity to learn about today.

# Notes from the Field

## WATERPROOFING SOIL TO COLLECT PRECIPITATION

LLOYD E. MYERS

***Development of inexpensive materials and methods to catch rainfall offers promising possibilities as a source of urgently needed water on the arid lands of the Southwest. This progress report on studies underway in southern Arizona indicates large-scale precipitation collection may soon be a reality.***

THE "last water hole" for most inland areas is not the ocean; it is the sky. Harvesting rainfall and snowmelt from specially treated hillside areas is an ancient art, first practiced more than 4,000 years ago. Cisterns and rain barrels to store runoff from rooftops were used by many families in the United States not too many years ago. But these old practices have disappeared from use as modern agricultural and municipal water supply systems have been developed.

Recent national emphasis on the development of urgently needed new water supplies has not included the possibility of harvesting precipitation, yet, this is the only new source of water in many areas of the United States. The problem is particularly serious on many range lands. Because porous soils soak up the rain there is little runoff, and therefore stock water ponds cannot be used.

C. W. Lauritzen found that during the year of 1954, precipitation totaling more than 8 inches occurred in 34 individual storms at a stock pond site near Tremonton, Utah. Although this precipitation amounted to more than 45 gallons per square yard of soil surface, no usable runoff occurred. Similar measurements and observations have been made at many other locations; they indicate the need and the opportunity for developing water supplies by harvesting rainfall and snowmelt.

The major problem in previous work on precipitation catchment structures has been the high cost of durable structures. Plastic films, metal sheeting, pre-fabricated asphalt mats, hot-mix asphalt, concrete, and other related materials have been used, but the cost for reasonably satisfactory structures has exceeded $1.00 per square yard. Attempts to reduce costs have been defeated by the lack of durability of the less expensive construction materials.

Development of low cost precipitation catchment structures was one of the first projects initiated at the U. S. Water Conservation Laboratory. It was decided to take an entirely new approach to the problem and to investigate methods of utilizing the soil itself as the catchment structure. Water repellent chemicals appeared to offer some promise for this purpose; because one goal was to keep application costs as low as possible, the investigation was limited to materials which could be sprayed on the soil surface. Results produced by some materials have been good and large-scale tests are underway on a treatment which promises to produce catchment structures for annual costs of about 2 cents per square yard. Assuming 80 percent precipitation recovery, a 1,000 square yard area costing $20.00, would produce 45,000 gallons of water from 10 inches of rainfall. This cost is low enough to make feasible the development of stock water supplies on arid range lands.

The development program includes both laboratory and field plot testing. In chemistry and soil mechanics laboratories materials are tested to determine effectiveness in waterproofing different soils, mechanical strength of treated soils, depth of treatment penetration, optimum dosage rates, reactions with salts in the soil, reactions with other chemicals involved in the treatment, etc. Materials which pass these tests are then applied to 30- by 30-inch soil trays which are exposed to natural weather conditions and simulated rainfall. Runoff from these trays is measured and any infiltration of water into the treated soil is determined by weighing. Indications of erosion or weathering are also obtained.

Treatments which survive the outdoor soil tray tests are then applied by hand spray to 5- by 20-foot plots in the field. Runoff from natural precipitation is caught in buried tanks, measured volumetrically, then compared with rainfall measured by

**Special equipment was designed to apply asphalt emulsion to large test plots. Equipment and materials for treating 5,000 square feet were carried easily in the pickup truck.**

*Lloyd E. Myers is director of the U. S. Water Conservation Laboratory operated by the Soil and Water Conservation Research Division of the Agricultural Research Service, Tempe, Arizona.*

a recording gauge and with runoff from a 5- by 20-foot butyl rubber sheet. The next step is the application of test treatments to 50- by 50-foot plots. Specially designed power spray equipment has been constructed and these plots are used to test the application equipment as well as the treatment materials.

Initial investigations showed that in addition to waterproofing the soil surface it was necessary to stabilize the soil against erosion and to prevent the growth of weeds in the treated area. Several commercially available repellent compounds were found to be suitable for waterproofing sandy soils at a low cost. About $10.00 worth of these materials will temporarily waterproof an acre of sand. Unfortunately a water repellent soil particle will float unless it is tied down or covered up, so this treatment created a terrific erosion problem.

Materials to prevent erosion were then studied. The most effective low-cost soil stabilizers evaluated so far have been sprayable asphalt emulsions. Although the emulsions are applied at low rates and do not form a completely watertight film, they still serve as an effective moisture conserving mulch when sprayed on the soil surface. A fine crop of weeds develops rather rapidly unless a soil sterilant, such as polyborchlorate, is used. The complete treatment now under field test involves three separate spray applications: First, a soil sterilant; second, an asphalt emulsion; and third, a water repellent chemical. Many problems have been encountered, but application of the correct amount and formulation of the asphalt emulsion has been the major one.

The original asphalt applications were made with a quick-break emulsion at a rate of 0.05 pound of actual asphalt per square foot. When sprayed on the soil surface, this emulsion broke almost immediately and so formed a surface film with little penetration into the soil. A 5- by 5-foot panel of sand, treated at the 0.05 pound rate, yielded about 85 percent of the simulated rainfall as runoff. However, the asphalt layer began to deteriorate after 10 months exposure to actual weather conditions. The failure, caused by mechanical wind damage, was due to a lack of sufficient asphalt to bind the sand particles into a strong surface layer. Since the asphalt contains some volatile fractions which evaporate over a period of several months, enough asphalt must be applied to provide good bonding after the volatile components are gone.

Treatments now under test have sufficient emulsion applied, on the basis of visual observation, to produce a good surface layer of asphalt and good penetration into the soil surface. Improved penetration has been obtained by using an asphalt emulsion which breaks more slowly after application. Depending upon the depth of penetration, the quantity applied varies from 0.1 to 0.2 pound per square foot. Penetration varies with soil type; it ranges from about one-eighth to one-half inch.

Outdoor test panels of silty sand sprayed with 0.1 pound asphalt per square foot have shown no cracking or other deterioration after 14 months of exposure to the Phoenix, Arizona, climate. Penetration and tight bonding of the asphalt to the soil seems to reduce greatly the deterioration of the asphalt caused by oxidation or evaporation of volatile fractions. Runoff characteristics are good. Artificial rainfall tests on plots on a 5 percent slope have shown that there is essentially no infiltration. Retention of water by the naturally rough asphalt and repellent treated soil surface is less than 0.02 inch from each "storm." This means that runoff from a 0.1-inch rain exceeds 80 percent of rainfall and runoff from a 1-inch rain exceeds 98 percent.

Large field plots have not been installed for a sufficient length of time to provide information concerning durability of the treatment. Experience with the 0.05 pound treatment and observation of test panels given the 0.1 pound treatment indicate that the 0.1 pound application will last well over a year.

Materials for the 0.1 pound treatment cost 5 to 8 cents per square yard; the soil sterilant cost 2 cents, asphalt emulsion costs 2 to 5 cents, and water repellent chemical costs 1 cent. Application and site preparation costs will vary widely, but it is believed the total cost of initial treatment will average about 10 cents per square yard.

Repair treatment is expected to be necessary after 1 or 2 years. Repair costs will be much lower than the initial treatment and the re-sprayed surface should be considerably stronger and more durable. The interval between repair treatments should increase as the treated layer is built up. With reasonably favorable site conditions the annual cost, including repair treatments, should be about 2 cents per square yard.

Results of the work so far are not conclusive, but they are extremely encouraging. Measurements and observations on test panels and field plots have shown that the present treatment is effective in waterproofing and stabilizing soil surfaces and is resistant to weathering under relatively frost-free conditions. Freezing is not expected to be a problem on reasonably well drained sites, but this factor has not yet been investigated.

Large test plots are being installed to evaluate and improve field application methods and equipment. Operational catchment areas will be installed soon on existing stock ponds where runoff is presently inadequate. The final answers, which are expected to be favorable, will be obtained from these operational areas. Improvement of materials and application equipment will be continued so that the principles of precipitation harvesting can be used to develop or protect other agricultural water supplies.

## FOR WHOM DO WE CONSERVE

MORRIS E. FONDA

MUCH OF THE PHILOSOPHY dealing with the broad field of conservation stresses the importance of conservation for posterity.

There is nothing wrong with this. Intelligent and wise use of land and water today is important for the people of the future—for posterity. But through such conscientious sentimentalism we have overvalued posterity's importance in stating the need for conservation.

The conservation of soil and water is closely knit with our free enterprise system. After all, what actually motivates an owner or operator to practice good land use? Concern for posterity? A desire to leave his land better than he received it? Influencing factors, no doubt. But the real motive more likely involves economics. Does it pay?

The American farmer is beset by revolutionary changes greater than the technical revolution which brought about tremendous increases in his productive capacity. The first cycle of agricultural development —producing more wheat, corn, legumes, grasses and many other crops—is pretty well along. Now the second big revolutionary step is getting underway—the job of producing livestock and its products as efficiently and economically as field crops.

One cannot help a farmer grow a better field of alfalfa on land that should have alfalfa on it and stop there. The job isn't done. We who serve the farmer must be on his team permanently. In advising

and working with him in conservation, it is my conviction, the conservationist cannot stop with containing the soil and water, or even with showing the land operator that he will produce more on land under a conservation plan. We must work with him through his entire livestock program and relate the products of conservation to the utilization of these products.

Furthermore, this conservation program must be closely associated with the individual farmer's marketing objectives. After he produces the crops, using an intelligent land use system, we should be deeply interested in the marketing phase of his business. Is our conservation farmer supplying the kind of product the market requires, and at the time the market wants it?

Mrs. Public does most of the buying of conservation products. What is her product preference these days, and what is the trend of her future demands?

In the first place, let us recognize that it is away from a starch-carbohydrate diet. Though she is still buying ample supplies of bread, biscuits, pastries of all sorts and similar food commodities, the projections show a declining per capita demand for most starch products.

On the other hand, there is a decided upward trend in the consumption of protein foods. Take red meat, for instance, from 1950 to 1960 there was more than an 11 percent increase in per capita consumption of red meat. A closer look shows that much of this increase was beef, with 63.4 pounds consumed per person in 1950 as compared to 85.8 pounds (this figure partly estimated) in 1960—an increase of 35 percent.

Is this meaningful to professional conservationists? It certainly is. And the wonderful part of it is that it meshes so well with conservation programming.

The trends also indicate that some of the old concepts of conservation as related to livestock production, that is, producing an acceptable product for the consumer, are probably in for major revamping. Take, for example, the whole idea of pastures, meadows, rotation grazing, supplemental pastures and similar cultural practices. There was the day (and at this moment there still is) when the dream of a conservationist was a lush pasture or meadow.

Or take another view on producing an acceptable roast, steak or hamburger for Mrs. Public. After forage has played its part in early growth, the conventional feeding practice is to fatten the animal on a ration high in grains. Grading standards

**Feeding the products of conservation farming. These beef animals are being fed a well-balanced ration of processed forage and grain for maximum gains at minimum costs. The farmer is realizing the benefits of conservation by efficiently marketing the crops he has derived from his land.**

are set up so that they recognize the fattest animal as the highest grade—prime.

But if we look more closely at the trends in meat consumption it is apparent that grading standards are in for changes. Less than 5 percent of the beef consumed is prime, the fattest grade. Is this because of price? Definitely not, it is because our consumer, the person for whom we conserve, simply does not want fat meat and she will not buy it. The alert conservationist thoroughly familiar with these trends will adapt his own planning and aid to farmers accordingly. What are some of these changes?

On other than marginal land, nearly any type of grazing is wasteful and inefficient. With optimum grazing practices only a small part of the nutritive potential of the plant can be captured. Even when a variety of species is used, top protein content diminishes and fiber content increases long before the crop is completely grazed.

The day of extensive pasturing on the better land is fast passing. Confined feeding, where forages are harvested at peak values and maintained in this condition for delivery to the animal's rumen, is nearly here. Push-button feeding, a minimum of animal stresses, maximum sanitation, and efficient materials handling will be the new order.

What does this mean? Simply this, there will be a decreasing emphasis on grain finished animals and an increasing emphasis on forage feeding, provided that it is the right forage, harvested at the proper time in an acceptable manner, preserved properly and fed efficiently. There will be a trend toward processing forages.

All of these trends point up the increasing importance of conservation, but not just for conservation's sake. As conservationists, the biggest challenge we face is to recognize that the results of our efforts have real meaning for posterity, an immediate value to the land owner and operator, and are of vital concern to the consumers who use the products of conservation. This is the kind of challenge that raises our vision from the soil where land use planning starts and permits us to see the results in a broader dimension.

It will help change us from technicians to conservationists serving a total objective. This type of effort will directly assist the farmer and rancher conserve land and water, help him operate a more profitable business, and most important, aid him in serving the consumer who benefits from the products of conservation.

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# GABIONS FOR STREAM AND EROSION CONTROL

ROBERT A. TOBIASKI AND NORMAN R. TRIPP

WATERSHED MANAGERS on the national forests, like watershed managers everywhere, are faced with problems of rehabilitating eroded areas, controlling stream bed movement and stabilizing stream banks. Permanent solutions to these problems are often difficult and almost always expensive. "Permanent" log cribbing rots out after a few years, structures of masonry or concrete may be undermined by shifting stream beds or pressures may build up behind a solid wall causing fractures and eventual failure.

In 1957, a "new" type of structure was tested for its ability to stabilize the channel of the North River above the Staunton Municipal Reservoir in the George Washington National Forest in Virginia. These new structures, or "gabions" use an old concept with a new application.

The "gabion" as defined by *Webster's New World Dictionary* is:

> "gabion (gā' bi-an) n. (Fr.; It. gabbione, large cage < gabbia, cage, coop. < L. cavea, cave, cage) 1. a cylinder of wicker filled with earth or stones, formerly used in building fortifications. 2. a similar cylinder of metal, used in building dams, foundations, etc."

As used on the George Washington National Forest, the gabion is a large wire mesh basket specially coated with zinc to insure long life under adverse conditions, rectangular in shape, variable in size, and with diaphragms or walled-off sections at approximately 3 foot intervals.

These baskets (figure 1), filled with small rocks, are used as "building blocks." These blocks, wired together in one or more layers, form the gabion superstructure. Where undercutting is probable, this superstructure rests on a thin, flexible footing or apron of gabions usually about 1 foot thick. This apron (figure 2), extending into the channel, will settle when undercutting or erosion occurs, thus, forming a permanent cutoff wall.

In the nearly five years that have passed since installation of the North River gabions, the structures have shown no signs of deterioration and have performed as designed. A moderately severe test occurred in May 1960 when the spring runoff reached the estimated 25-year frequency discharge rate. Further tests of gabion structures are being made on the Monongahela National Forest in West Virginia and the White Mountain National Forest in New Hampshire.

The inherent flexibility of the gabions—the ability to bend without breaking—seems to be the primary reason for their success. Other important advantages are permeability, stability, ease of repair, and relative economy.

### *Flexibility*

Because of their flexibility, structures built of gabions can adapt themselves, without loss of efficiency, to changing river bed conditions. Where rigid structures may be undermined and collapse, these flexible structures merely shift to conform to the new contour. The same flexibility permits them to yield sufficiently to absorb impacts which might be expected to breach the seemingly lightly fastened structure.

### *Permeability*

Because they are filled with small rocks these structures are highly permeable. The porous nature of the gabion permits water to flow through, thereby reducing pressure against them, and when used for weirs, reduces the necessary size of the spillway opening. When used as retaining walls this same characteristic permits through drainage and greatly relieves the buildup of hydrostatic pressure behind the wall.

### *Stability*

Although gabion structures are usually built without footings or foundations they have great stability. This is achieved by wiring the gabions together at the edges so that the units form a single mass which has great weight without sacrificing flexibility.

### *Ease of Repair or Alteration*

Other advantages of gabions are ease of repair, replacement, and alteration. If, for any reason, one of the links break or shear, the multi-twisted mesh remains intact to keep the basket from opening any further and spilling. The break can easily be mended by stitching with a piece of the same coated wire used for connecting wires in the gabion or any other good quality galvanized wire.

Replacement or alteration is a comparatively simple matter. The ties and fill are removed and the basket replaced or removed to the desired position. Additions need only be tied to the existing structure and filled.

### *Economy*

When compared to most rigid or semi-rigid structures, a gabion installation is economical because:

**1** Foundation preparation is not needed. Gabions can be laid on any relatively smooth surface where they can be wired together and filled.

**2** The actual cost of gabions is much less than for any other known form of permanent structure. Costs will vary depending on roughness of terrain and availability of suitable fill material. Where fill material was availabe on site in the George Washington National Forest, the costs have varied from $10 to $15 per linear foot of wall for the combined apron and first tier of superstructure. The second tier of superstructure has varied in cost from $5 to $8 per linear foot.

**3** Any kind of stone of reasonable size can be used as filler material. Very often, it is available at the job. However, even when the stones have to be quarried,

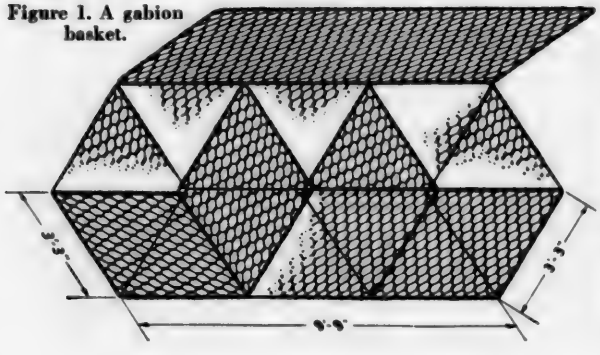

Figure 1. A gabion basket.

Figure 2. The gabion apron follows the contour and settles as erosion occurs, thus, forming a permanent cutoff wall.

Figure 3. The water is slowed but still permitted to pass through this gabion weir.

Figure 4. These groins constructed of gabions divert water away from the river bank.

the use of gabions is still relatively economical.

4 Gabion construction is simple and does not require skilled labor. Almost any laborer can become proficient in gabion construction in a very short time.

Gabions have long been used for torrent control, slide and stream bank stabilization and other erosion control work in European countries. Some of these structures are reported to have stood for nearly a century with no signs of serious deterioration.

### Other Uses of Gabions

Because of their inherent characteristics, gabions are adaptable to many other uses.

1 Weirs or drop structures used in stream control are especially effective when constructed with gabions because the water is slowed, but still permitted to pass through (figure 3). They also serve as a stilling basin to trap sediment. The weir may be combined with gabion walls to protect upstream and downstream banks. Whether or not the weir is tied to the walls, it must be securely anchored to the river banks.

2 Groins are used to control river flow and stop bank erosion by directing river currents away from the bank (figure 4). Gabion river groins are usually placed at intervals four to six times the length of the individual section and, for best results, a minimum of two to three groins should be used. By placing a groin at right angles to the bank, it is possible to protect equal lengths of the bank, both upstream and downstream. Inclining the groin downstream protects more of the downstream bank, while inclining the groin upstream does the same for the upstream bank.

3 Low water bridges or fords are feasible on most small streams and the use of gabions for this purpose has been very satisfactory. In the tests in the George Washington National Forest, a single row of gabions was built on each side of the road and the center filled with rubble (figure 5).

The surface was leveled for better riding characteristics. When the water is low, it seeps through the structure as a kind of low water bridge. It is equally efficient as a ford in higher water. In either case, the structure is stable. It also acts as a "sill" to prevent bed load movement.

4 Debris basin or check dams made of gabions should be especially efficient (figure 6). As with the weir and drop structure, water pressure against this structure is comparatively low and the sediment trapped behind the dam will help make it more stable. Cross channel structures to control flow of the North River in the George Washington National Forest are acting in this capacity and doing an excellent job.

5 Retaining walls made of gabions and used along roads to hold slides, seep areas, etc., are also efficient structures. Bridge abutments and pier protection fall into this category. The natural attributes of gabions, such as flexibility, permeability, stability, and economy, make them most adaptable to this type of construction, particularly in mountain streams where rapid changes in volume and velocity occur.

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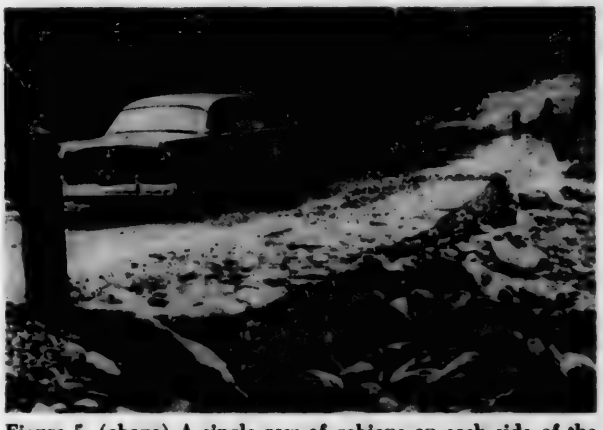

Figure 5. (above) A single row of gabions on each side of the road holds the material in the center of this low-water bridge.

Figure 6. A check dam built of gabions has nearly 12 feet of sediment behind it.

# Medium Purple Willow for Muckland Windbreaks

DAVID H. DAWSON

ONE of the perennial problems associated with the growing of crops on organic soils in Michigan is that of severe wind erosion. High winds in early spring frequently make it necessary for farmers to replant considerable acreages of truck crops, particularly carrots and onions. In addition to the expense of reseeding, large amounts of soil are lost. One storm can cause the loss of an inch of topsoil and completely fill drainage ditches (*1*).

One of the conservation practices for preventing wind erosion commonly accepted by muck farmers is the planting of primary and secondary windbreaks. As mucklands were drained and cultivated the need for windbreaks was evident; however, neither suitable plant species nor technical information on their use was available.

Consequently, through the years many miles of black willow and Van Houtte spirea were planted. They offered some wind protection, were readily available, and were easily propagated. Black willow is objectionable because early in its life it loses its lower branches and develops into a large tree with high branches that give little ground wind protection. It competes for nutrients and water from a large area on either side of the windbreak, and due to its extremely brittle branches is very "dirty," making it necessary to rake up branches each year before tillage operations begin.

Van Houtte spirea does not get tall enough to offer good protection and because it is shaped like a vase there is an objectionable hole between each plant in the windbreak. This hole acts as a funnel for the wind and as a result the crop is damaged; sometimes the windbreak itself is blown out.

Because less-than-adequate plant materials were available, the establishment of windbreaks has not progressed with the development of muckland. Technicians assisting the Lapeer Soil Conservation District calculated a need for 600 miles of windbreak in that district. Farmers were "ready, willing, and able" to plant this amount, if more satisfactory materials could be found.

In 1955 and subsequent years, a series of 15 field plantings of secondary windbreaks were initiated by the Soil Conservation Service on the organic soil farms of soil conservation district cooperators. Soils on which truck crops are normally grown are Tawas, Carlisle, and Houghton mucks.

Tall purple willow, medium purple willow, blue arctic willow, Amur privet, Regal privet, Van Houtte spirea, multiflora rose, purple lilac, sweet mockorange, forsythia, Pekin cotoneaster, and silky dogwood are the species being compared. These plantings have been evaluated by the muck farmers and technicians each year since they were planted.

### Results of Field Plantings

During the first 2 years after planting the limitations of some species became obvious: Forsythia and mockorange frequently winterkilled, Amur privet defoliated when subjected to certain insecticides, multiflora rose was difficult to work near because of its thorns.

Evaluations during the third and fourth growing seasons more definitely indicate the plants' suitability as windbreak materials: Tall purple willow—which had appeared very desirable earlier—grew too broad and "open"; Tartarian honeysuckle and purple lilac, although relatively tall and narrow, were too "leggy" and open near the base; silky dogwood, Pekin cottoneaster, and Regal privet exhibited good growth form, but their rate of growth was slower than some of the other species.

During the fifth growing season it was apparent that medium purple willow (*Salix purpurea gracilis, Grenier and Godron*) and blue arctic willow (*Salix purpurea nana, L.*) were considered by the muck farmers and evaluating technicians as being superior to other plants in the trials. Plants were about 8 feet tall and very dense. The windbreaks formed by the willows were completely free of weeds.

**Figure 1. Black willows have been used extensively in the past as muckland windbreaks. Note the undesirable trunks, open areas near the ground, and debris of dead branches.**

*SCS Photo*

### Nature and Behavior of the Plant

Medium purple willow is a shrub, a subspecies or variety of the more common purple osier willow (*Salix purpurea, L.*) (*2*).

There are several varieties of purple willow. Medium purple willow is extremely dense and fine twigged. Plants grown on muck for 6 years have twigs averaging not over one-half inch in diameter at the base and only about one-eighth inch in diameter at the tips. In six growing seasons the plants have reached a height of 8 to 9 feet and are 6 to 7 feet wide. The foliage is an attractive blue-green color and in the latitude of central Michigan appears on the plant around the middle of April.

Due to its relatively narrow and upright growth form, and a tendency for the lower branches of the plant to meet at the base, medium purple willow is evidently slightly more suitable than blue arctic willow as a secondary windbreak plant. Blue arctic willow exhibits a broader growth form with openings between plants near ground level.

There have been no insect, disease, or other problems associated with the plant in the 6 years of observation.

### Adaptation

Present recommendations for windbreak spacing in Michigan are based largely on previous research (*3*) (*4*) and observational data.

Primary tree type windbreaks using two rows of Austrian, Scotch, and white pine at minimum distances of forty rods have been recommended for some time. However, it was learned by the muck farmers and technical workers that primary windbreaks alone were not adequate to control damaging wind action on the highly erodible muck soils. Consequently, secondary shrub-type windbreaks have been employed every 150-200 feet between the primaries. The place for medium purple willow is in these shrub-type windbreaks.

Successful plantings have been made on drained and undrained organic soils (peats and mucks) with Ph ranges from 5.8 to 7.0.

Although no damage to drain tile caused by plants growing over them has been reported, positive data are not available as to the possibility that roots of the plant might plug tile.

### Field Plantings and Culture

Rooted cuttings appear to be most desirable for planting purposes. Plantings should be made early in the spring on cultivated mucklands. Cuttings should be spaced 2½ feet apart in the row. Plantings made by hand, plow, and tree planter have all been successful.

Normal cultivating procedures on the lands adjacent to the windbreaks have kept competition adequately suppressed. During the year of planting, some farmers have felt it desirable to hand hoe between plants. After the first growing season the plants have usually grown together enough to suppress weeds within the row.

### Summary

In 15 field plantings established between 1955 and 1959 on drained and undrained muck soils, medium purple willow has been evaluated and found to be a good secondary muckland windbreak material. Plants have developed into a windbreak 9 feet high and 7 feet wide. It has given better results than 11 other shrubby species when the secondary windbreaks were used with primary windbreaks. Propagation of the plant is by cuttings. No insect or disease problems have been noted.

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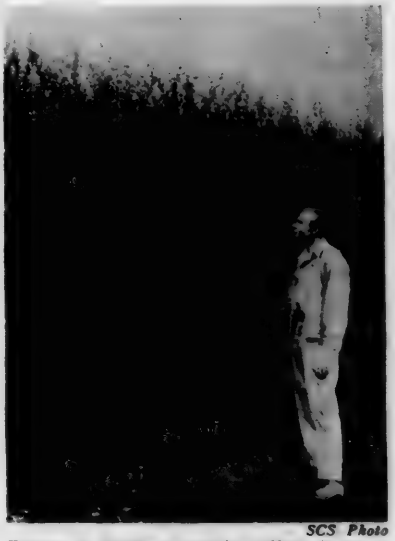

SCS Photo

**Figure 3. Medium purple willow forms a dense barrier after five growing seasons.**

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# Maintaining Vegetation on a Bulldozed Right-of-Way

EDWARD R. SMITH, JR.

MAINTAINING OF RIGHTS-OF-WAY by utility companies is expensive. These areas must be treated periodically to prevent trees from growing into powerlines and so that inspection and repair of the facilities can be made quickly and easily. Various methods are being employed to control this unwanted vegetation. Hand cutting, disking and bogging, spraying with chemicals, mowing, and bulldozing have all been employed in right-of-way maintenance. These treatments are all expensive and the length of time each is effective varies a great deal.

A major problem faced by the utility companies is determination of the most economical methods. Recent studies by one North Carolina utility corporation indicated that bulldozing was the cheapest method per unit of maintenance-free time. However, this company has discontinued bulldozing and is now mowing their rights-of-way with a rotary mower (brush-hog). While bulldozing was the cheapest method, its effects upon the land were highly undesirable.

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During a study of four bulldozed rights-of-way in the North Carolina Piedmont region[1] it was found that in the process of bulldozing rights-of-ways to remove unwanted vegetation, much of the topsoil was pushed to the sides. Devoid of protective vegetation, the exposed slopes and ridgetops eroded rapidly. After a year or so, only the lower soil horizons or parent material remained, and in some cases bedrock was exposed. On land eroded to this degree, the problem of unwanted vegetation has been solved for quite some time.

Some of the eroded soil was deposited in the bottomlands. The depth of these colluvial deposits bear mute testimony to the amount of soil that must have been removed from the slopes above them. In most cases the original bottomland soil could not be reached with a 42-inch auger. Heavy silt loads carried from the rights-of-way also contributed materially to silting of stream channels and riverbeds in the area.

On the rights-of-way studied, woodland site index[2] information was gathered and equivalent data were taken on the adjacent woodland at the same time. Data analysis showed that bulldozing had lowered the

**Erosion is rapid on bulldozed rights-of-way. Vegetative control is no longer a problem here.**

*SCS Photo*

[1] Smith, Edward R., Jr. 1959. *A preliminary study of vegetation on North Carolina Piedmont and mountain power transmission line rights-of-way.* Unpublished master's thesis. North Carolina State College, Raleigh.

[2] Coiles, T. S. 1952. *Soil and the growth of forests.* Advances in Agron. 4

*SCS Photo*

**Because of better soil conditions, the bottoms are revegetated before the slopes and hilltops. Note the excellent reproduction of pine further up the slope.**

site indexes of rights-of-way by an average of 10 feet, except for colluvial and alluvial areas where the site index increased because of deposition.

Natural revegetation of these denuded areas was very slow. On most of the sites it took 4 to 5 years before adequate cover was present to arrest erosion. But even 5 years after bulldozing some areas were still eroding because they were so sterile that vegetation could not survive.

The vegetation that volunteered after bulldozing was a mixture of herbs, grasses, shrubs, vines, and tree seedlings and sprouts. Except for poorly drained soils or those areas where marshy conditions occurred, the 10 most common plants found on all areas were blackberry, partridgepea, cinquifoil, broomsedge, aster, trumpetvine, wild strawberry, pine, bedstraw, and wild lespedeza. Because the bulldozing had modified original conditions so much, normally significant factors such as soil type, topographic location, exposure, and soil depth, had little effect on plant succession or species composition.

While species composition was similar, the density of these plants was largely dependent on three factors: (a) The lapse of time since the right-of-way was bulldozed (vegetation density increased with time), (b) the topographic position of the plant (the bottoms were revegetated before the slopes and the slopes before the ridgetops), and (c) the severity of erosion that had taken place (the more eroded the site, the slower the vegetation returned).

Though these rights-of-way were cleared for the purpose of eliminating tree species, bulldozing actually encouraged them by providing an ideal seedbed. The type of seedbed furnished is favorable to the species which grow rapidly. The seedlings most abundant on the bulldozed areas were pine, yellow poplar, and sweetgum; all prefer a seedbed of mineral soil and are among the fastest growing trees in the southeastern United States. Thus, bulldozing a right-of-way is actually self defeating for it creates improved conditions for the return of trees.

The value of these bulldozed rights-of way to wildlife was also explored carefully. Signs of wildlife were quite common after the third year, and conditions for game animals became better with each succeeding year up to 6 years. Quail, rabbits, and turkeys were known to be present on the study areas.

On the 5 and 6-year-old areas, many desirable seed and fruit bearing plants were found; these included blackberry, beggartick, strawberry, lespedeza, honeysuckle, grape, green and yellow foxtail and greenbrier. There was also an abundance of browse supplied by grasses, herbaceous growth and stump sprouts. Beetles, crickets and grasshoppers were also present. Beneficial wildlife cover was furnished by blackberry and honeysuckle thickets, stump sprouts, pine seedlings and thick grass.

If these areas could be held in the vegetative condition that occurred at the end of 6 years after bulldozing, they would be highly beneficial to wildlife. However, between 6 and 8 years after the initial clearing, they are recleared and lose their value to game animals. Perhaps the mowing of these older areas with rotary mowers, as is being done in a few cases, would help retain this successional stage and prolong the usefulness of these areas for wildlife.

Bulldozing as it is commonly practiced opens up rights-of-way to accelerated erosion, destroys wildlife food and cover, and encourages the establishment of fast growing trees; but by modifying this practice its undesirable effects can be greatly reduced. Newly developed clearing blades and root rakes do not disturb the topsoil as much, yet they effectively remove trees and brush. Establishing perennial shade tolerant plants such as sericea or shrub lespedeza and fescue will help prevent the re-entry of tree species on the right-of-way. Root sprouts or seedlings that do manage to get through this plant cover can be eliminated by an occasional mowing.

So that the right-of-way is most accessible to the utility company and is of greatest benefit to wildlife, the lowest growing vegetation should be planted in the center and the taller growing species established next to the woodland.

Arner[3] stated that 3 years after planting, the cover on a bulldozed right-of-way in Maryland was only 9 percent woody plants. The cost of bulldozing and seeding this area, using 1951 prices, was $45.59 per acre; bulldozing cost $40.00 and seeding $5.59.

A similar situation was observed by the author in North Carolina. A quarter-mile section of right-of-way that had been planted to shrub and sericea lespedeza was examined. Only two or three tree seedlings were found and these were located in a spot where the stand was thin.

Gas companies with buried piplines enjoy a definite advantage in planting their rights-of-way. Not only is the problem of erosion solved, but gas leaks can readily be detected through the distinct color change in the vegetation above the leak.

It would be worthwhile for utility companies to test these planting techniques and observe the advantages: The longer maintenance-free periods, the prevention of erosion through soil stabilization, the improved wildlife carrying capacity of the areas, the economies of operation effected, and the improved public relations.

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[3] Arner, D. H. 1951. *Experimental planting on powerline rights-of-way and woodland roads.* Trans. N. Am. Wildl. Conf.

# CONFERENCE ON ROADSIDE EROSION CONTROL

B. H. HENDRICKSON

*The first conference on roadside erosion control at Cartersville, Georgia, was held on June 1-2, 1960. The purpose of the conference was to review the research program of the Coosa Watershed Project and to provide a forum for the interchange of ideas relating to the control of erosion from bare roadbanks bordering highways in the hilly upper Piedmont formation in northwest Georgia. The work on the 3½-year-old Coosa Watershed Project is of regional and national significance for it is aimed directly at roadside erosion control.*

THE Coosa Watershed Research Project is unique in that the actual soil and water losses from six typical cut roadbanks are under continuous measurement, and for the first time in the Southeast a comprehensive series of roadbank cover species and revegetation methods are being tested. A dozen or more types of mulch and 30 plant species are now being evaluated on over 700 replicated plots located on roadbanks 10 to 30 feet high and from 1:1 to 4:1 slope.

The cut roadbanks along principal highways of the area are deeply weathered. The parent rock is overlaid with infertile, acid subsoil and substratum unconsolidated residual materials. The profiles are derived from massive granite and associated metamorphic rocks. Cecil soils predominate. The upper subsoil is largely clay, 4- to 5-feet thick; this grades into coarser and less stable sandy substrata and rotten rock resting on bedrock 25 to 50 feet below the surface.

Specially designed equipment to measure soil and water losses was installed at the lower end of each road ditch bordering six bare roadbanks. These installations have been in operation since January 1, 1958. The banks selected are in pairs on opposite sides of State Highway 92, and are located 15 to 18 miles south of Cartersville. The banks, 15 feet high and approximately 250 feet long, are on 1:1, 2:1 and 3:1 slopes. Installations include recording raingauges, and at each ditch-end there is a lead-in flume, H-model weir, waterstage recorder, 24-inch diameter Coshocton sampler, and a covered tank.

A series of metal hub stakes placed in the road ditches are used as reference elevations for periodic depth measurement of road ditch sedimentation or erosion. A second series of metal stakes, originally set at 4-foot intervals in lines across the bare roadbank surfaces, have gradually become exposed as erosion occurs. They provide visual evidence of the removal of as much as 2 inches of soil per year.

Bare roadbanks are losing soil at a rate as high as 300 tons per acre per year; this is 10 to 15 times more soil loss than from typical sloping Class III• fields in continuous cotton on farms having the same soil type. Adjacent similar roadbank sections in established permanent covers of bermudagrass and lovegrass were effectively protected over the 3-year period. The tops of the stakes have remained flush with the bank surfaces.

On another series of widely separated roadbanks within a 20-mile radius of Cartersville, many plant species were tested for their ability to produce and maintain adequate growth and effective cover. Among the summer species, common bermudagrass and lovegrass have performed well. Bermudagrass stands established by seeding spread to form complete coverage. Lovegrass produced stands more quickly, but did not thicken well from partial initial stands.

Seedbeds were satisfactorily prepared with a chain harrow if slopes were no steeper than 2:1. On steeper slopes, the loosened soil rolled down to the base of the banks. Applied mulches were required to retain most of the seeds on steeper banks and also to reduce fertilizer washoff losses. Mulches supplied protection against raindrop impact and reduce rilling. They also gave protection against freeze damage to seedlings and from spew frost action.

Among the fall-sown cool-weather species, tall fescuegrass proved to be one of the best perennials. Abruzzi rye did well and produced its stand quickly. By the spring following fall seeding it had formed a grown-in-place straw mulch. The growing rye plants and the straw provided nurse-crop protection for the slowly-developing winter-legume seedlings. Rye appears to be especially valuable for seeding with crownvetch in the fall for the rye protects the legume during its seedling stage.

Most of the roadbank planting sites have been heavily fertilized because of their exceedingly low nutrient content and relatively high washoff rate during the stand establishment period. In most cases, 2 tons of lime and 1 ton of 4-12-12 per acre have been applied as blanket treatments. An additional 50 pounds per acre of nitrogen is applied as needed on grasses in spring or summer. The general follow-up treatment during the second year has been application of one-half ton of 4-12-12 per acre. Plantings of broomsedge, a poor-land plant, were not so heavily fertilized; they did just as well with treatments of 500 pounds per acre of 4-12-12 the first year and 250 pounds per acre the second year.

Continuing studies are designed to determine the most practical roadbank revegetation methods at lowest costs for establishment and maintenance.

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*The conference was jointly sponsored by the Coosa Watershed Research Project of the Southern Piedmont Soil Conservation Field Station operated by the Agricultural Research Service, the Georgia State Highway Department, the Soil Conservation Service, the Georgia Agricultural Experiment Stations, and the commissioners of Bartow County, Georgia.*

## They Alter Implements to Handle Stubble Mulch

EMIL R. HOPPE

SOMEONE has said, "There is nothing new under the sun!" But he should have added "only basic ideas with a new twist of application." For that is just what farmers in the Palouse hills of Washington are doing with tillage and seeding equipment to solve some of the problems encountered when working and seeding stubble-mulch fallow.

Older pieces of equipment, as wheat ranchers know, have several weaknesses. Generally they do not have sufficient clearance for working through crop residues. This is especially apparent with sweeps under 30 inches when mounted in multiple gang units, and it is also true of many pieces of spring tooth equipment used for initial and follow-up tillage.

Another common fault of older equipment is the lack of uniform depth control of most sweeps on both heavy and light spring tooth implements. Still another weakness is the lack of side-slip control of all tillage and seeding equipment on sloping or hilly ground.

Ingenious farmers and implement manufacturers are improving equipment so that it will handle even the heaviest crop residues when the equipment is properly used and adjusted.

The lack of clearance still exists, however, on the spring tooth and the duckfoot cultivators. This deficiency becomes most apparent when this equipment is used to cultivate weeds in a stubble mulch when wet weather makes the rod-weeder useless and even the skew treader only partially effective. Springtooth equipment built by farmers near Walla Walla, Washington, demonstrated that such equipment, if built in 8 to 10 foot sections mounted on wheels and with frames 26-30 inches off the ground (with standards or teeth match i.e., 26-30 inches in length), would handle mulch straw when spring toothing was preceded by one disking or one or two skew treading operations.

Uniform depth control on the initial stubble mulch tillage is highly essential if the follow-up tillage is to be effective, especially when rod weeder use is planned.

Immediate follow-up tillage is a must when mulch fallow is started in order to kill cheat before it goes to seed. If initial tillage depth varies from 3 to 12 inches the first 2 rod-weeding operations will effectively control cheat at the 3 inch depth but will be almost useless at the 12 inch depth. This is especially true if frequent showers occur and the soil remains wet. However, if the initial tillage is uniformly 4 inches deep the moisture line is then set and early winter wheat seeding can be done with deep furrow drills, seeding wheat directly on the firm moist soil. Uniform stands can be expected.

Lack of uniform depth control is largely brought about by excessively wide individual units carried on two wheels with a rigid tongue to the tractor. Four wheel bearing surface on units not more than 8 feet in width would help overcome this problem on all spring tooth type tillage equipment. A compensating hydraulic hitch mounted on wheels is being successfully adapted to take the place of the two front wheels on equipment such as the heavy spring tooth, the tool bar, and other equipment. It is solving the four wheel suspension need on present two wheeled rigid tongue equipment. The long rigid tongue is removed and individual sections or units are hooked to the hitch draw bar by a short swivel or hinge coupling.

Merlin Phillips, farming northwest of Walla Walla, Washington, built a couple of 10 foot precision depth tillage equipment units (figure 1). He used 2 old rod weeder frames from which he removed all goosenecks and rods. Then he attached a "toolbar" across the bottom of the frame half way between the front and rear wheels. To the bar he attached rigid shanks supporting 24 inch sweeps. "The only thing that needs improvement," he said, "is the vertical clearance. This I hope to accomplish by replacing the present shanks with longer ones."

Stubble mulch benefits for erosion control and moisture intake, with resulting consistent higher yields, has made any effort to design and build equipment to handle it successfully well worth the cost and time expended.

---

*Emil R. Hoppe is soil conservationist with the Soil Conservation Service, Walla Walla, Washington.*

**Figure 1. To assure positive depth control when working on sloping land, Merlin Phillips developed this unit with 24-inch sweeps.**

*SCS Photo*

## DATES TO REMEMBER

**American Society of Agricultural Engineers Winter Meeting.** December 13-15. Palmer House, Chicago, Illinois.

**American Association for the Advancement of Science, Section O (Agriculture).** December 26-31. Denver, Colorado. "Land and Water Use" is the theme for the Section O Symposium. A general symposium, "Water and Climate," will be sponsored by the AAAS.

**National Association of Soil Conservation Districts Sixteenth Annual Meeting.** February 4-9. Sheraton Hotel, Philadelphia, Pennsylvania.

**Fertilizer Technology Short Course.** February 12-13. Purdue University, Lafayette, Indiana. Sponsored by Soil Science Society of America.

**North American Wildlife and Natural Resources Conference.** March 12-14. Washington, D. C.

**National Wildlife Week.** March 18-24. Sponsored by National Wildlife Federation.

**Ninth National Watershed Congress.** May 7-9. Deshler-Hilton Hotel, Columbus, Ohio.

## AUDIO-VISUAL AIDS

**Film: Watershed Conservation.** 16 mm., 11 minutes, sound, color, 1961. U. S. Department of the Interior, Bureau of Land Management, Washington 25, D. C.

This film stresses the urgency of doing something now to protect the country from flood, erosion, and water pollution and shortage.

**Film: Operation Glen Canyon.** 16 mm., 28 minutes, sound, color, 1961. U. S. Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

This film tells the story of the men and machines now at work constructing Glen Canyon Dam on the Colorado River in northern Arizona. Upon completion, this structure will be the western hemisphere's second highest concrete dam.

**Film: Eruption of Kilauea, 1959-1960.** 16 mm., sound, color, 1961. U. S. Department of Agriculture, Motion Picture Service, Washington 25, D. C. $111.35.

This film records the spectacular eruptions of Kilauea Volcano on the island of Hawaii in 1959 and 1960. It was photographed by scientists from the Geological Survey and the National Park Service. A short animation scene shows how volcanos grow, and actual recordings of the fountaining noise made by the volcano are included on the sound track.

# NEWS NOTES

## PROCEEDINGS OF THE FIFTH WORLD FORESTRY CONGRESS

During the fall of 1960, nearly 2,000 men and women representing 71 countries gathered in Seattle, Washington, for the Fifth World Forestry Congress. The Proceedings of this historic conference are to be published in three volumes totaling 1,800 pages. Each paper will be published in full in either English, French, or Spanish with summaries in the other two languages —1,386 pages in English, 234 in French and 180 in Spanish.

The Proceedings can be purchased only through advance orders placed prior to January 1962. The three volume set costs $25.00 and remittance should be enclosed with an order directed to: Proceedings, Fifth World Forestry Congress, c/o Forest Service, U. S. Department of Agriculture, Washington 25, D. C.

## NATIONAL MERIT AWARD

The State Soil Conservation Committee of Virginia was recently accorded the Merit Award by the *Soil Conservation Society of America*. This coveted award was presented in recognition of the superior publication, "Water Resources of Virginia," produced under the auspices of the Committee and entered in the *Society's* award program by the Virginia Chapter.

The presentation was made by *Society* President-elect Roy Hockensmith at the annual meeting of the Virginia Chapter of the *Society* on October 20 in Charlottesville. During the award ceremonies Hockensmith said, "'Water Resources of Virginia' is a factual document containing reliable data on water and related natural resources; it is written in a style that is easy to read and understand; and it is filled with illustrations and photographs of exceptional quality. The publication was given this national recognition because of the influence it has had in getting an understanding of the need for conservation engrained in the thinking, doing and living of both urban and rural people."

## DOUGLAS NAMED SECRETARY

Philip A. Douglas, fisheries biologist with the California Department of Fish and Game, has been named as Executive Secretary of the Sport Fishing Institute. He succeeds Robert Paul who accepted appointment as administrative assistant to the Assistant Secretary of the Interior for Fish and Wildlife.

## 1963 ANNUAL MEETING THEME

The Utah Chapter of *SCSA* will be hosts for the *Society's* 1963 Annual Meeting. It will be held on the campus of Utah State University at Logan, August 25-28. All *Society* members are urged to help determine the theme for this meeting. Send your suggestions and ideas to the Executive Secretary, *SCSA*, 838 Fifth Avenue, Des Moines 14, Iowa.

## WORLD SOIL MAP

The Food and Agriculture Organization of the United Nations and the United Nations Economic, Social and Cultural Organization are jointly undertaking the preparation of a world soil map.

This map should provide a realistic picture of the distribution of the major soils and should enable soil scientists to draw conclusions as to how different soil areas can be used.

The first phase of the work will be the preparation of regional maps bearing an integrated legend: Australia in 1962; North America, Central and South America, Europe and the Near East in 1963; North and central Asia (which together with Europe contains the area of the U.S.S.R.), south and southeast Asia, and Africa in 1964. In this way a series of continental maps and a first look at the world soil map will be available for the next Congress of the International Society of Soil Science to be held in Romania in 1964.

The second phase will be the preparation of a second draft of the world map in 1966, with final publication planned for 1968 in the form of a loose-leaf atlas comprising some 40 sheets.

## HYDROLOGY PROGRAM

A new program in scientific hydrology has been established by the College of Mines at the University of Arizona. The comprehensive course of study will lead to the degrees of Bachelor of Science, Master of Science and Doctor of Philosophy in the field of water resources.

## SESQUICENTENNIAL

The 150th anniversary of the establishment of the old General Land Office, predecessor of today's Bureau of Land Management, will be commemorated at a special observance in Washington, D. C., on April 25, 1962. The General Land Office was inaugurated on that date in 1812; it was merged with the Grazing Service in 1946 to form the Bureau of Land Management.

**U. S. Senator Carl Hayden, an Honorary Member of the *Society*, and Secretary of the Interior Stewart Udall admire the Senator's giant 84th birthday cake. The cake and the American Forestry Association's coveted Distinguished Service Award were presented to Hayden on October 2 at Santa Fe, New Mexico, at the 86th annual meeting of the Association. Senator Hayden was born on October 2, 1877, in Hayden's Ferry, now Tempe, Arizona. When Arizona was admitted to the Union in 1912, Carl Hayden was elected to the United States House of Representatives. He served there until 1926 when he was elected to the Senate. His record of 49 years and 8 months continuous service in the United States Congress is unmatched.**

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## COMMISSION FOR HYDROLOGICAL METEOROLOGY

The Commission for Hydrological Meteorology was recently created by the World Meteorological Organization, one of the specialized agencies in the United Nations complex. The Commission is to serve as a technical organization to consider hydrological problems of international concern.

The first meeting of this commission was held in Washington, D. C. in mid-April with delegates from 30 countries present. *SCSA* members Herbert C. Storey and Harold O. Ogrosky were among the nine man delegation sent by the United States.

## LAND EROSION SYMPOSIUM

The Section of Hydrology, American Geophysical Union, plans to participate in the "Symposium on Land Erosion" to be sponsored by the International Association of Hydrology and scheduled to be held in Bari, Italy, in October 1962.

Members of the *Soil Conservation Society of America* are invited to submit abstracts (not more than 250 words) of proposed presentations by January 1, 1962.

The Association has formulated four general subjects which will serve as the basis of the symposium: (a) Description of testing instruments—artificial sprinkling, soil humidity, measurement of bed load and suspended sediment, kinetic energy of rain, etc.; (b) cartographic description of effects and factors of soil erosion, use of aerial photography; (c) optional subjects, particularly fluvial morphology, transport of solids, soil erosion; and (d) visits to experimental stations and to regions most subject to erosion, particularly the Apennines and southern Italy.

Those interested should forward inquiries or abstracts to Dr. M. Gordon Wolman, Chairman, Committee on Erosion and Sedimentation, AGU Section of Hydrology, Isaiah Bowman Department of Geography, The Johns Hopkins University, Baltimore 18, Maryland.

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## INTERNATIONAL PLANT INDEX

A vast undertaking to catalogue all of the earth's plant life on IBM cards is now in progress. For many years botanists have been identifying and naming plant life, but scientists working at different times and in different places have often attached different names to the same plant. This has resulted in a confused situation which the taxonomists of the world would like to remedy.

Sydney W. Gould, director of the International Plant Index, explained that the automatic compilation will provide one master index of the world's plants (estimated at 1,700,000) by group, family, genus and species names. Gould and his staff have now completed 50,000 cards, organizing the plant kingdom down to the group level, and are now working on genus identification. When the project is completed, the index of the plant kingdom will be published in some 50 volumes as a master reference for researchers throughout the world.

A grant from the National Science Foundation supports the project.

**The winning team in the National Collegiate Soil Judging Contest hails from the Tennessee Polytechnic Institute at Cookeville. (Left to right) Nolan Turner, Gordon Burt, Thomas Allen, Robert Groce and Professor W. J. Huddleston, team coach. The national contest was held May 5-6 at the University of Kentucky. Huddleston, director of the School of Agriculture at the Institute, is a member of the Council (governing body) of the *Soil Conservation Society of America*.**

## NEWS OF MEMBERS

**Wendell R. Tascher**, for many years the extension soil conservationist for the Federal Extension Service, has resigned because of ill health. His home address is 5012 Newport Avenue, Washington, D. C. Tascher has served on the Chapter Activities and the Fellow and Honorary Members Committees of the *Society*, in addition to contributing several articles to the JOURNAL. He was named to the Degree of Fellow in the *Society* in 1959.

**Robert E. Williams**, range conservationist on the Washington-field staff of the Soil Conservation Service at Athens, Georgia, has been named as a member of the Service's Farm and Ranch Planning Division, Washington, D. C. **Horace L. Leithead**, range conservationist from Denver, Colorado, now fills the position left vacant by Williams in Georgia.

**J. H. Christ**, first secretary of the *Society* upon its organization in 1945 and named to the Degree of Fellow in 1957, will retire from his position as state conservationist for the Soil Conservation Service in Hawaii on January 1.

**George Worley**, a professor at the University of New Mexico, was elected president of the Conservation Education Association at that group's recent meeting in Missoula, Montana. C. W. Mattison is the retiring president.

**Homer A. Taff**, assistant state conservationist in charge of the Great Plains Conservation Program for the Soil Conservation Service in Texas, was selected to attend the Resource Use and Planning Seminar at the University of Michigan. The seminar program began on September 1 and will conclude about June 1, 1962.

**Robert Dils**, professor of cooperative watershed management at Colorado State University, will head the nation's first avalanche control study. The investigation was made possible by a $15,000 grant from the Rocky Mountain Forest and Range Experiment Station. Dils will be assisted by Hans Frutiger, an avalanche specialist with the Swiss Snow and Avalanche Research Institute, Davos, Switzerland.

**Quentin R. Boerner** has been appointed head of the Cooperative Watershed Management Section in the U. S. Forest Service's Southern Region. In this assignment he will direct planning and program administration concerned with the Forest Service's responsibilities under Public Law 566.

**Wallace L. Anderson's** "Making Land Produce Useful Wildlife" has been a "best-seller" among U. S. Department of Agriculture publications. Over 730,000 copies have been distributed.

**Paul McGrew**, state conservationist for the Soil Conservation Service in Washington, will retire on January 1. In 1952, Mr. McGrew served the *Society* as second vice president, and in 1957 he was named to the Degree of Fellow.

**Alfred Hedge**, a member of the Washington, D. C. office staff of the Soil Conservation Service, will retire on January 1. Hedge was a member of the committee that developed the *Society's* "Soil and Water Conservation Glossary" and in 1956 the Degree of Fellow was conferred upon him.

**J. B. Earle** was recently named as assistant state conservationist for the soil conservation service in Louisiana.


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## CHAPTER NEWS

**Wisconsin Chapter.** In 1958, the chapter initiated action that has culminated in the publication of "Land Planning Principles—for Land Use in Wisconsin." At that time, Cy Kabat, chapter chairman, established a land utilization committee and charged it to "set forth guiding principles to further the understanding and appreciation of resource conservation."

Melville Cohee was given the assignment of writing the platform or broad framework within which the committee would consider separate land use fields and their inter-relationships. At the chapter's annual meeting in January 1959, he presented a preliminary paper dealing with this area. Membership response was accompanied by formal action endorsing the Land Utilization Committee work plus a request for more intensive action. The committee was reorganized so that members represented the major land uses in Wisconsin and were located within a radius of 100 miles from each other. During 1959 and 1960 this committee met for nine different full day sessions. Between formal committee meetings, copies of outlines, first draft copies, etc., by individual committee members were circulated.

At the chapter's 1960 annual meeting the committee presented a current draft of principles. Again there was favorable endorsement of the committee's work and action was taken to develop a publication.

The booklet covers principles and recommendations for future programs regarding lands used for six major purposes: agriculture, forestry, urbanization, highways, recreation, and wildlife. A preface is included under the heading, "Forward Wisconsin." The six main sections of the treatise are preceded by a brief foreword that stresses the need to capitalize on progressive past developments in Wisconsin.

An orderly future programming of these six major uses of land is emphasized throughout the publication. Separate coverage of each of the six purposes positively indicates its interrelation with the other five purposes.

**Oklahoma State University Student Chapter** was officially organized on October 18. John R. Bogard was elected student chapter chairman and David Ihle was named vice chairman. John Spitzer is the chapter's secretary while James Smith was elected treasurer and Wendell Arnold was named as reporter. Edd Roberts, extension soil conservationist with the Oklahoma Extension Service, was elected as faculty advisor.

**Hoosier Chapter** (Indiana). "Recreation and Conservation" will be the theme of the chapter's annual meeting to be held on January 5 and 6 at Bloomington. This will be the first 2-day annual meeting held by the chapter.

On November 16 and 17, Hoosier Chapter members promoted a special membership drive. On each of those days every chapter member was to explain the *SCSA* program to at least one prospective member, then invite him to join.

**Inland Empire Chapter** (Washington and Idaho) members will gather in Spokane for their annual meeting on December 9 at the Coeur d'Alene Hotel. The theme of the first presentation by a panel will be "What should we do with diverted acres?" Dr. Robert Nilan will appear on the noon luncheon program.

Fifty-nine boys attended the 1961 Natural Resources Youth Camp jointly sponsored by the Chapter, the Pacific Northwest Section of the American Society of Range Management and the Inland Empire Section of the Society of American Foresters. Bill Eyler, *Society* member from Spokane, was camp director.

**Golden Spread Chapter** has recently been organized and will hold a "charter night" on December 5 at Amarillo, Texas. William Brooks, work unit conservationist for the Hansford Soil Conservation District, is temporary chairman for this group which is located in the Texas Panhandle.

**Georgia Chapter** has recently published in mimeographed form the Proceedings of the chapter's fifth annual meeting. This useful and attractive 41 page booklet contains six excellent papers and a brief history of the chapter from 1950 to 1960. W. E. Adams of Watkinsville is currently the chapter chairman.

**Mississippi Chapter.** The West Central Area of the chapter held a box supper and fellowship evening at Mississippi Power and Light Company's lodge on October 26. Dr. W. B. Andrews discussed the role of members of the *Society* in advancing the science and art of good land use.

**San Juan Chapter** (Puerto Rico). An informative field trip to observe intensive coffee production and conservation on steep mountain lands was held on October 13. The farms of Luis Becerra and Jose Marquez were visited.

**West Virginia.** Jackson's Mill was again the site for an excellent annual meeting held September 22-24. Papers presented dealt with flood control, the West Virginia Department of Natural Resources, economic trends in land reorganization and treatment, activities of the Fish and Wildlife Service in the state, road bank stabilization, multiple use of the national forests, evaluation of wildlife plantings, outdoor education, and use of conservation farm plans in managing woodlands.

**California Chapter.** On November 17, the San Francisco Bay section of the chapter enjoyed a social evening at the Treasure Island Officers Club. After dinner, Mr. and Mrs. Charles Kraebel gave an interesting account of their experiences in Formosa.

The California Chapter annual meeting will be held in San Diego at the U. S. Grant Hotel, January 25-27.

**Nebraska Chapters.** The first statewide meeting of all *SCSA* chapters in Nebraska was held in Lincoln on November 17 and 18. The superior technical program featured reports on the 1961 water quality survey in Nebraska, the use of a rainfall simulator in runoff and erosion research, and progress in applying minimum tillage to corn. Other papers of exceptional quality dealt with range management programs for Nebraska, an intensified soil fertility program in Richardson County, and inhibition of germination and seeding development by crop residues. Over 150 persons attended.

**Oregon Chapter.** Plans for the annual meeting to be held on December 15 in Portland are now complete. The chapter presented an award at the state fair this year to the best conservation exhibit produced by a 4-H club. Expansion of the award program to include other groups is being contemplated.

**East Tennessee Chapter** members held their annual meeting and banquet on September 16. The three sub-chapters reported on development of programs in their areas.

Vernon Berry of Rogersville was elected chairman of the Upper Valley sub-chapter at a recent meeting. This sub-chapter has been particularly active in promoting land judging contests and roadbank stabilization programs.

**John T. Carson, Jr., (right) head of the Biology Department at George School in Newtown, Pennsylvania, was presented the William Penn Chapter's Annual Conservation Award by Hamilton K. Pyles, chapter president, at the chapter's annual meeting on November 2.**

**Iowa Chapter.** More than 100 persons attended the chapter meeting held on October 27 at Eldora. Interesting and informative presentations dealing with pumping irrigation wells, F.H.A. soil and water conservation loans, farm pond liability, the mechanics of settling farm claims, and wheel track planting of corn were given in the morning. During the afternoon a vivid account of personal communications in action was delivered by the president of the Iowa Garden Club, and a panel of the top newsmen in the state discussed "What makes soil and water conservation news?"

**North Carolina Chapter.** On October 20 and 21, the annual chapter meeting was held on the campus of North Carolina State College in Raleigh. Featured speaker at the Friday evening banquet was David S. Weaver; his topic was "The Urgency of Conserving America's Resources."

**Northern Illinois Chapter.** The new headquarters building of the Illinois Agricultural Association in Bloomington was the scene for the eighth annual chapter meeting on October 25. An excellent news release, prepared for mailing to hometown news media by those in attendance, indicated that 161 persons were present. The role of conservation in providing for Illinois' recreational needs was the main theme of the meeting. According to the report of the chapter's Land Improvement Committee, 700 feet of diversion terraces and several demonstration grass plots were added to the chapter's Conservation Demonstration Area in the Kankakee River State Park this year. Ray T. Lynge was named chapter chairman for 1962, Robert Oertel was elected vice chairman, and Marilyn Clark will be secretary-treasurer.